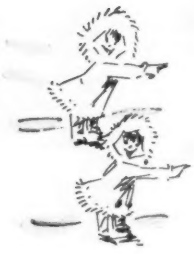
Consulting Engineer

October 1960

Photo by Fabian Bachrach

HUGH P. DUFFILL, of Duffill Associates, Boston, president of the Massachusetts Association of Consulting Engineers, is one of those rare persons who listens to the arguments before he makes up his mind. When he does make a decision, it is clearly his own, and based on all of the facts that have been put before him.

Continued on page 22



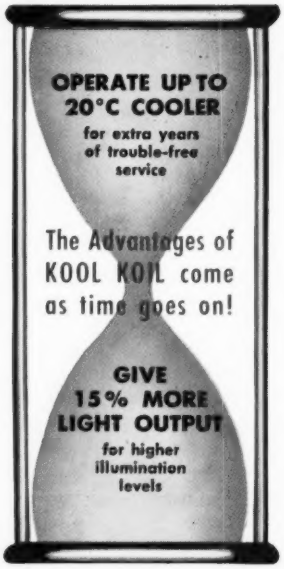
LONGER BALLAST LIFE

Ballast life is cut in half for each 10°C over normal operating temperatures. ADVANCE KOOL KOIL BALLASTS operating 16.5°C to 19.5°C cooler give 3½ to 4 times longer life.

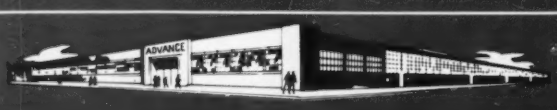
20% LESS WATTAGE LOSS

This higher efficiency of ADVANCE KOOL KOIL BALLASTS offers fluorescent lighting users savings in operating costs and manufacturers the opportunity to increase fixture efficiency.

The design of ADVANCE KOOL KOIL BALLASTS is the result of 3 years of research, a great stride in solving the heat problems of the lighting industry. Advance engineers separated vital components in the ballast case to end costly condenser trouble. They developed new grades of steel and wire, incorporated special insulating materials and compounds. The result, ADVANCE KOOL KOIL FLUORESCENT LAMP BALLASTS that end costly maintenance and interruptions in service. Insist on ADVANCE KOOL KOIL, designed and built to last for the life of your lighting installation.



"The Heart of the Lighting Industry"



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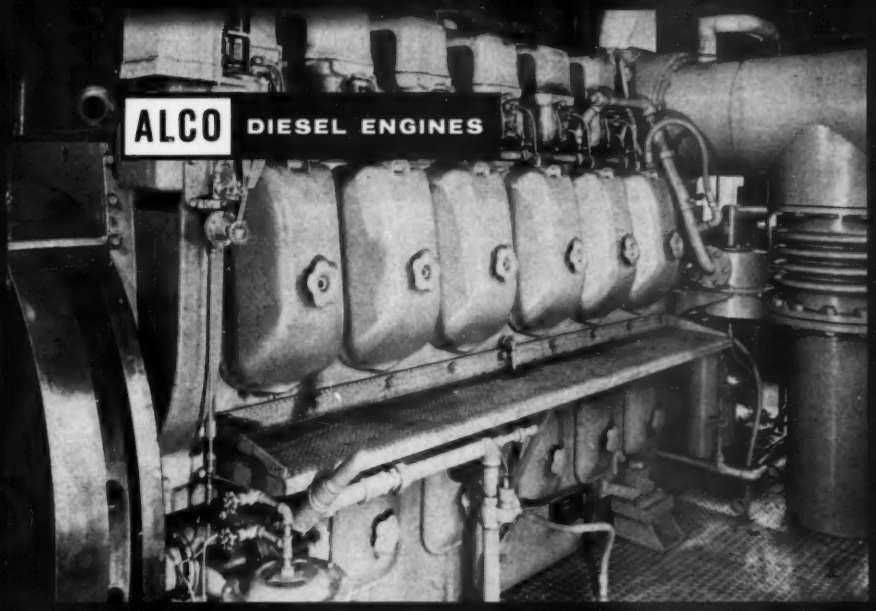

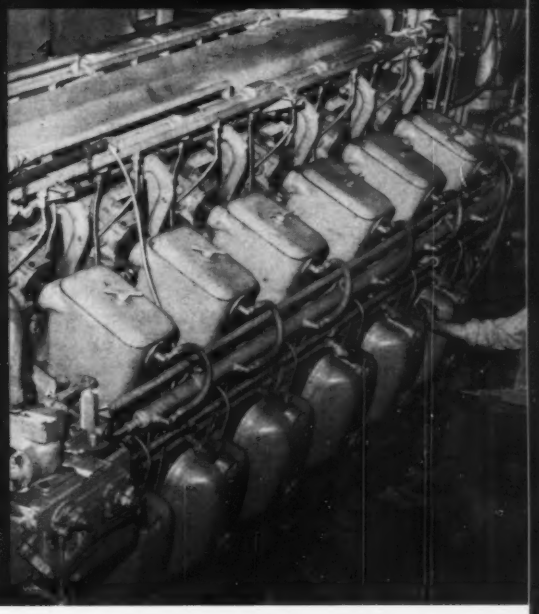

THE NEW BIG MUSCLE IN DIESELS

Around the world—in all kinds of tough diesel-power jobs—ALCO's 251 diesel engine has proved that it delivers the versatility, economy and stamina needed for profitable operations. Here are a few examples:

1. Microwave signals from 100 miles away direct an ALCO six-cyl 251, pumping liquid petroleum products on a Kansas pipeline. After two years of remote operation —8000 total hours—an inspection revealed the engine could run at least twice as long without overhaul.

2. Three 251's provide power for a large offshore drilling platform. The operator reports that fuel consumption is much lower than competitive engines, while the 251's controllability allows him to speed up costly drilling operations.

3. Tugboats like the *Savannah* use 16-cyl 251's to get power for heavy tows on high seas. Operators report low maintenance, with three to four years' operation before overhaul. The 251's fuel consumption—15 per cent less than competition—permits longer tows.

4. A steel company uses an ALCO 251 as standby, pumping cooling water to open hearths. Recently, during a power stoppage, the 251 assumed the whole pumping load, saving thousands of dollars of furnace damage in a single instance.

ALCO 251's—available in inline six, vee 12 and 16, from 900 to 2400 hp—are your best investment. For more information, call your ALCO sales office, or write: ALCO Products, Inc., Dept. 1201, Schenectady, N.Y.

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ALCO

".....we knew you would want all these switchgear advances. And we were determined to bring them to you at the lowest possible cost."

—Frederick G. Schmidt, Manager Switchgear Division, I-T-E Circuit Breaker Company

Frankly, we had a big decision to make when we were designing this new HK metal-clad switchgear. Should we go ahead with a complete redesign or should we simply add the new features we knew you wanted to our previous models? The latter would have been easier, and it still would have put us well ahead of the field. But we decided it would be more honest to give you the benefit of as much progress as possible as soon as we could. And we were confident that in this case we could give you all these advances at a price no higher than you would pay for equipment with none of them.

First we wanted to give you stored energy closing. No circuit breaker in this class can really be called modern today without this feature. It insures that you can have fast, uniform closing every time. In fact, I-T-E makes it possible for you to close the breaker even during emergencies when you have lost control power. Fast closing reduces breaker upkeep—prolongs contact life. And I-T-E's motor-driven spring charging mechanism needs only about one-tenth the power of other devices. So you can enjoy the economy of a smaller battery or control transformer.

To give you still greater safety too—again with no increase in cost—we designed this switchgear so you never need open the doors to move the breakers. You can go all the way from connected through test position, to disconnected, and back again with the door closed.

Where else can you find safety like this in metal-clad switchgear? Even an inexperienced man can operate it in complete safety. Because we were designing this equipment completely new from the ground up, we had the opportunity to make the components more accessible and provided more elbow room inside the compartments. The bus is higher, for example, making installation and inspection easier. The control cables are brought in at the front for convenience and safe access away from the high-voltage bus. The current transformers are located behind the shutter in the circuit breaker compartment and may be easily changed without disassembling the bus or cable connections.

We were meticulous from the beginning about taking full advantage of the many new materials now available for switchgear use. And through careful selection of materials, skillful arrangement of components, and shrewd economy of space, we were able to give you all these advances in a substantially smaller package as standard equipment. The gear fits under lower overheads and in narrower aisles. Yet it gives you actually more usable space inside than you had before. Circuit breakers are lower, lighter and easier to handle. Instruments are at eye level. We believe you will agree there is no finer switchgear available today anywhere.

A complete description of this equipment is contained in our new illustrated Bulletin 2801-2A. Send for your copy. And ask to see our new sound strip film. We'll bring it to your office. You can see it in 18 minutes. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

Consulting Engineer®

For Engineers in Private Practice

Wayne near Pleasant Street
Saint Joseph, Michigan

OCTOBER 1960 • VOLUME XV • NUMBER IV

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TRIPLING a shower room's CAPACITY with emphasis on safety .

Imaginative engineering found a "better way of doing things" to solve the problem of overcrowded locker and shower room conditions at Niles Township East Community High School. Not only was locker space greatly increased and shower capacity tripled—the shower room itself was provided with major safety benefits, practically foolproof water temperature regulation and economy of operation.

The showers are the progressive type, used primarily for warming up or cooling down on entry or exit to pool or gym. Located in what was once unused space, they are arranged in three double tiers, one set at 95°, one at 100° and the other at 105° by means of three Powers Hydroguard Thermostatic Controls.

Showers are operated from a convenient panel to which only the instructor has access. Here, through an "on" button, a timer actuates three valves connected to the Hydroguards to limit water flow to 10 minutes. The shower system can be shut off at any time by depressing an "off" button which automatically re-cycles the timer. In addition, individual switches for each tier provide manual operation when desired.

Core of the system is the Powers Hydroguards, set to the previously mentioned water temperatures. The Hydroguards protect the bathers at all times against temperature fluctuations that might cause scalding or other mishaps. Should either the hot or cold water supply fail, they immediately shut off the showers.

From an operational standpoint, four-year figures show that controlled timing and controlled temperature can lower a school's budget through water and fuel conservation.

Niles Township East Community High School

Architect: Edwin C. Bruno, A.I.A., Skokie, Ill.

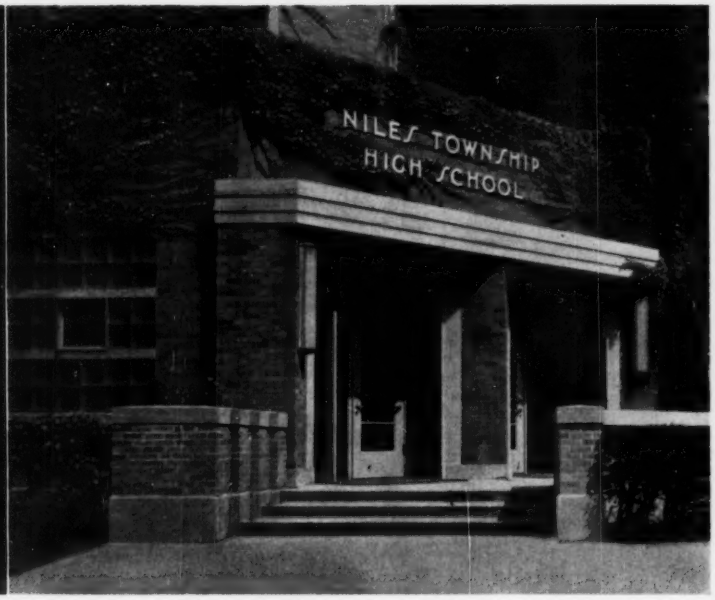
Consulting Engineer: John S. Horner, Libertyville, Ill.

Plumbing Contractor: Chas. Conrick Co., Chicago, Ill.

Head Custodian: Jules P. Roels

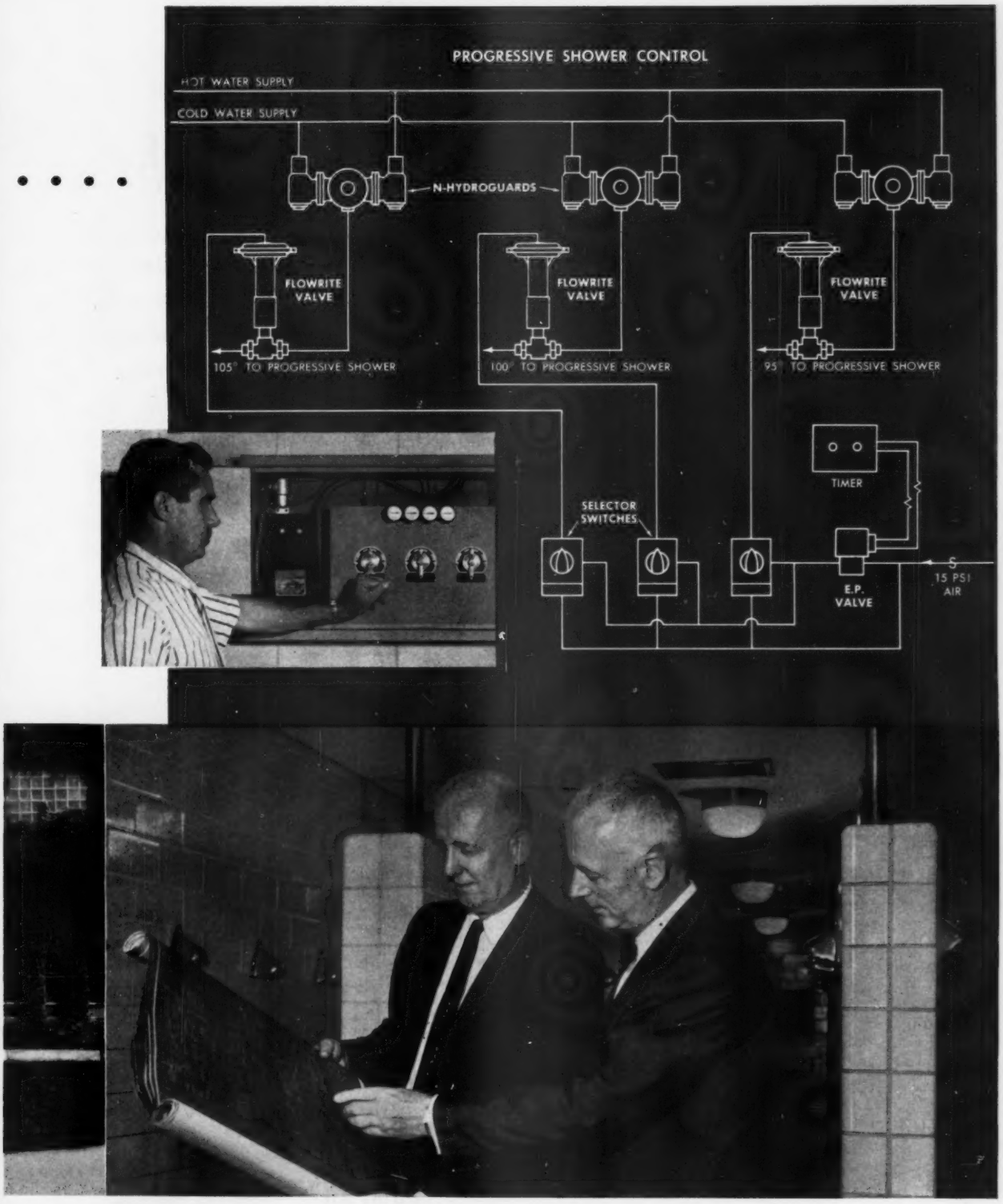
Upper photo on facing page shows Jules P. Roels at the operating panel.

In lower photo, John S. Horner and Edwin C. Bruno stand at pool end of shower.



Why not investigate a Hydroguard Shower System for your school? Just tell us about your requirements and we'll make recommendations with no obligations attached. For general information request *Safer Showers* Bulletin.

Also: POWERS TEMPERATURE AND HUMIDITY CONTROLS. Ask for case histories illustrating how Powers equipment has been engineered to individual needs to spark new ideas in indoor comfort and environment.



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EFFICIENT AIR MOVER FOR YOUR
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Since the finest air conditioning system available is no better than the fan that powers it, the Buffalo Type BLH Fan merits your most serious consideration.

The BLH is a better fan for your high-pressure system. It's a heavy-duty fan for Classes III and IV service. It offers the highest efficiency over the broadest range. In addition to the quietest, smoothest air ride from inlet to outlet (thanks to curved inlet bell, inlet guide vanes, inlet wheel flange matching the curved inlet bell, backward curve blades and graduated housing) it has the unique Buffalo divergent outlet providing smooth outlet flow and high static regain. For efficiency at high pressures, the BLH is without equal — and for dampered operation, Buffalo Variable Inlet Vanes can be substituted with less than 1 percent reduction in catalog rating; performance that cannot be equalled by conventional variable vane design.

Bulletin F-200 contains performance, construction, capacity and dimensional details. Your copy will be mailed promptly on request.

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Buffalo air handling equipment to move, heat, cool, dehumidify and clean air and other gases.

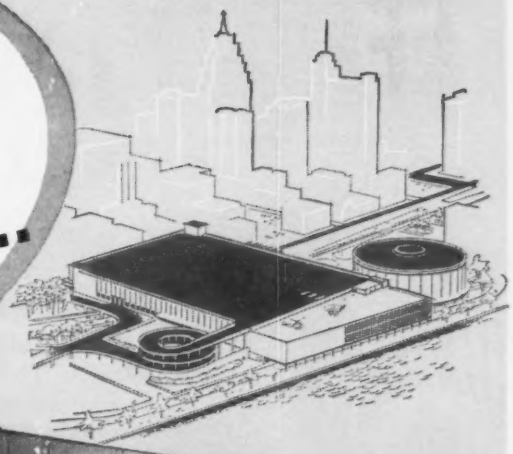
Buffalo Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

Buffalo Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

11 SQUARE D SUBSTATIONS SERVE COBO HALL...

World's largest exhibition building, COBO HALL occupies 10 acres of Detroit's Civic Center



...capable of supplying 22,000 KVA of continuous power!

Square D Field Engineer Don Selby *(right)* and Mr. Gil Brandt, Project Electrical Engineer of Giffels and Rossetti, architect for COBO HALL, examining one of the drawout circuit breakers in the low voltage secondary portion of a Square D 2000 KVA double-ended unit substation equipped with nitrogen-filled transformers

Easy, fast installation was a prime objective when eleven Square D unit substations went into COBO HALL. The various sections of each substation were completely coordinated at the factory. Reconnection of those sections at the job site required a minimum of time and labor.

Design leadership is very much in evidence in Square D's broad line of unit substations. We suggest a three-point comparison to prove the point—ease of installation, minimum maintenance, maximum safety for both equipment and personnel.

AMONG OTHER SQUARE D EQUIPMENT IN COBO HALL

31 Control Centers
28 Switchboards
450 Panelboards
75 Contactor Panels
1 Dimmer Board
10 Dimmer Panels
16 NEMA 4-Circuit Interrupters
120 Spotlight Control Panels
19,000 feet of Lay-In Duct

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wherever electricity is distributed and controlled

Your Editor

In a little manual for advertisers, *How to Sell a Consulting Engineer*, we said, "The consulting engineer, as an individual, is an educated professional man . . . He probably belongs to several learned technical societies and is a member of a good civic organization . . . He is a well rounded, intelligent person who knows politics, Picasso, or Prakofiev as well as he knows pozzolithic cement."

When we wrote this we did not have our editor, Hunter Hughes, in mind. But we well might have had, for an editor must have the same interests and educational background as his audience. He must indeed be a part of the profession itself, so that he knows intuitively not only what the profession wants, but more important, what it needs.

To be a part of the group he serves, the editor must spend most of his time with the group – in their offices, in their professional societies, on their projects. Since the first issue of CONSULTING ENGINEER magazine almost 8 years ago, Hunter Hughes has visited consulting engineers from one coast of this country to the other; and he has been to Europe 3 times in the last 4 years to visit consulting engineers from Oslo to Rome, from London to Berlin.

As a result, Hunter Hughes knows more engineers in private practice than anyone else in the profession. He is internationally recognized – both by the profession and by the laity – as an authority on private practice, and he has done more than any other single person to promote public realization of the importance of the consulting engineer.

Where the welfare of the profession is involved, Hunter Hughes is tireless. When the Hoover Reports were loosely cited as authority for governmental use of engineers in private practice, Hunter Hughes got the facts. And he got the facts, characteristically, from the best source, the archives of the Library of Congress. This involved countless hours of peering at microfilms of the source data, several thousand miles of travel, and endless correspondence and phone conversations with the principals. The story he wrote and published – the facts – were disappointing to our readers. But it ended once and for all the use by the profession of a defective weapon in this important battle.

This analysis of the Hoover Reports is typical; for Hunter Hughes and his entire editorial staff are determined to make every issue of CONSULTING ENGINEER a source of interest and service to the profession.

Russ Roe

Managing Director

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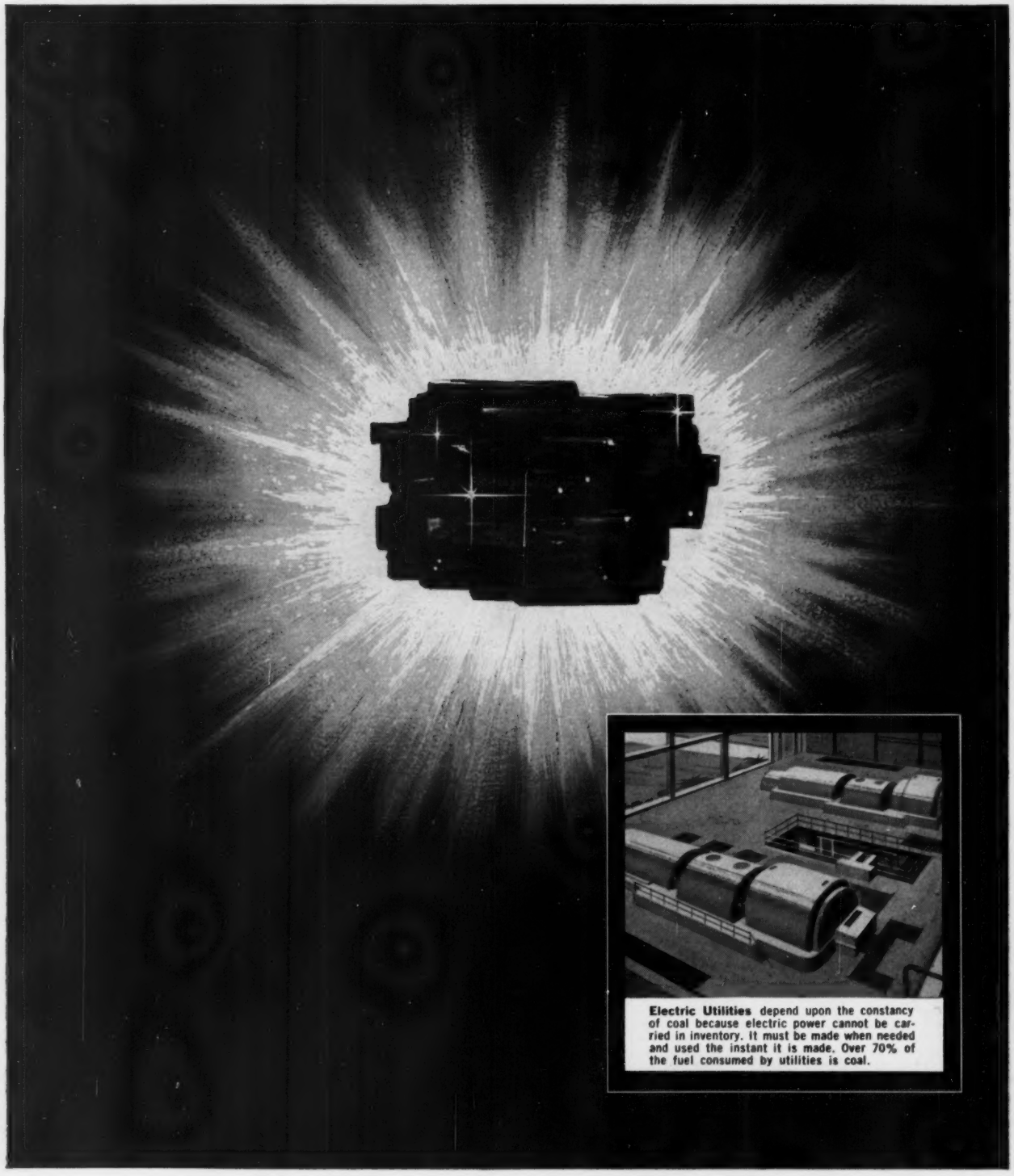

Electric Utilities depend upon the constancy of coal because electric power cannot be carried in inventory. It must be made when needed and used the instant it is made. Over 70% of the fuel consumed by utilities is coal.

ER COAL!

COAL IS ENERGY... producing low-cost kilowatt-hours for modern electrical living

As more and more Americans turn yesterday's household luxuries into today's necessities, electricity continues to be the greatest single force lifting our standard of living. In the last ten years our population has increased 20%. But the residential demand for electrical power during that time has risen 251%! For commercial and industrial use there has been a 150% increase. To satisfy this growing and boundless demand for dynamic energy, the electric utility industry has just about doubled its capacity every decade, all the while improving its fine record of giving more and more power for the consumer dollar.

Power companies are the biggest single user of coal. Nearly 70% of fuel-produced electric energy is generated by coal. Our country's five most efficient power plants, based on the 1958 report of the Federal Power Commission, operate 100% on coal.

In this booming energy market—and in other industries including steel making, process steam and heating as well — coal is the favored fuel. It offers the highest efficiency at lowest cost. It can match the stride of future consumption... is dependably, economically transported as needed by Chesapeake and Ohio's giant coal car fleet — and its abundant reserves can be counted upon for centuries.

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Coal is clean as well as economical for modern institutional heating. Advancements in handling and combustion equipment, electrostatic precipitators and other devices to prevent air pollution make coal the ideal fuel.

C&O Fuel Service Engineers offer free consultation in C&O's market areas on any problem of combustion, application, equipment or plant arrangement. Write to: R. C. Riedinger, General Coal Traffic Manager, at the address above.

The 5100-mile Chessie Route directly serves over 300 mines in America's richest bituminous coal reservoir with the finest fleet of 68,000 coal cars. Specify C&O routing for dependable, efficient delivery.

CHESSIE SERVES THE COAL BIN OF THE WORLD

The Readers' Guide

Bureau of Public Roads

(page 93)

There are among our readers some who have not always had the friendliest feelings toward the foreign design work in which the Bureau of Public Roads has sometimes engaged. Perhaps an engineer in private practice may be forgiven if he is less than happy to hear that the job for which he was negotiating with a South American government was given to the United States government. But, according to Ellis Armstrong, Commissioner of Public Roads, that is not quite the whole story. The Bureau, says Armstrong, is not out to compete with the consulting engineer. Quite the contrary. The Bureau wants to establish, in the less developed countries, highway departments and highway construction and maintenance methods of a type that will permit the development of modern highway systems where now there are only footpaths and wagon tracks. This, as Armstrong sees it, will mean a much greater need for consulting engineers in the carrying out of future highway plans. He says that the prime objective of his department, in its foreign activities, is training of a local highway department. Any design work is simply for demonstration. He explains this in his article, "What the Bureau is Doing Abroad."

Contract Documents

(page 104)

Most consulting engineers find contract documents extremely dull reading outside of court. All they really want is a set of general conditions that cover all situations to the complete satisfaction of everyone connected with any conceivable project. This ideal has not yet been achieved but the Consulting Engineers Council, through a committee headed by George Poulsen, of Salt Lake City, has come up with an excellent set of standard contract documents that simplify matters for most consulting engineers most of the time. Poulsen, in this issue, explains the right way to use contract documents, and he puts up an excellent argument for the arrangements worked out by him and his committee. Incidentally a complete set of standard contract documents can be purchased from Consulting Engineers Council, 326 Reisch Bldg., Springfield, Illinois.

Solar Control

(page 111)

Modern office buildings, standing naked in the city, need some sort of protection to prevent broiling in summer and freezing in winter. All manner of answers have been devised — setting them in the shade of other buildings; screening them with exterior blinds, shades, or honeycombs; or cleverly positioning and shaping them so that the sun is excluded during hot weather and let in for the winter. This is one of those problems that calls for both the architect and the engineer, for it involves not only shape and space, but materials and mechanics. It is logical, then, that Voorhees Walker Smith Smith & Haines, an architect-engineer firm, should have their own sun machine to guide them in calculations and considerations pertinent to this problem. The machine and how it works is explained in an article on which many VWSS&H people collaborated.

Engineering for the Moon

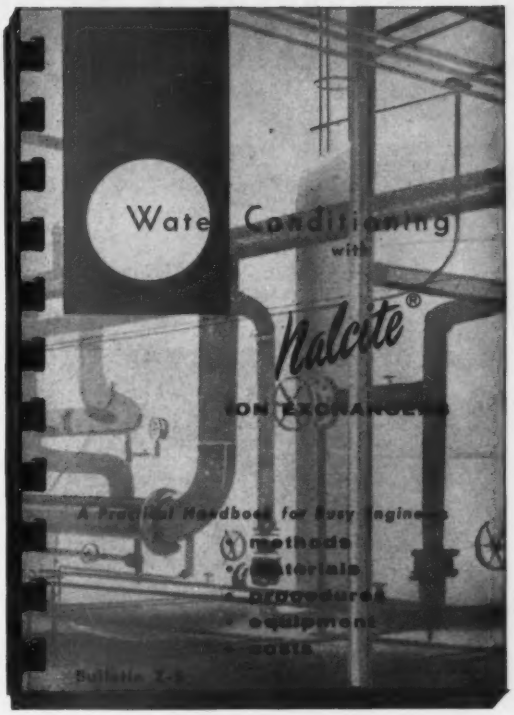
(page 86)

Man on the moon is imminent. Therefore, structures on the moon are practical projects actually on some drawing boards. The difficulties are diverse in an environment in which there is no atmosphere, the temperature varies more than 500 F on a fine day, and *g* is a lot less than 32.2. These basic differences make nonsense of an amazing number of earthbound formulae. This whole fascinating subject is discussed in some detail by Zusse Levinton, an associate partner of Tippetts-Abbett-McCarthy-Stratton.

Practical Help on Ion Exchange In Industrial Water Treatment

Request Your Copy of This New Nalcite Water Conditioning Manual

Information for Consultants, Engineers, Management Men on Practical Aspects and Possibilities of Versatile Nalcite Resins



For men who are interested in corrective treatment of water supplies, but who are not necessarily water chemists, Nalco's Ion Exchange Division has produced a handbook on water conditioning with Nalcite Ion Exchangers. Practical, *usable* information is given to provide a sound working knowledge of ion exchange methods, materials, procedures, equipment and costs. Useful charts, graphs and tables are included.

Better Water = Better Operation

Since water is one of the most important raw materials utilized in any plant, it follows that water of better quality will cut overall costs and improve plant operating efficiency. These improvements can range from elimination of scale and corrosion in water- and steam-carrying equipment through reduced maintenance and outage time, to better finished products.

Ion Exchanger Versatility

Nalcite Cation and Anion Exchange Resins, used separately or in combination, with or without other water treating materials, do an amazing variety of water conditioning jobs, from simple softening of hard water supplies to removal of dissolved solids to *0.1 part per million*, or less!

Processes to Fit the Need

Each of the commercially-used ion exchange processes is described in this manual, with data on the right Nalcite resins for the job. With the work sheets provided, the process best suited to any requirement can be calculated. Costs, chemical handling, instrumentation and waste disposal are given practical consideration for each process.

How Nalcite Resins Fit In

Nalcite Ion Exchangers are a vital part of complete water treatment plants designed and manufactured by reputable equipment companies. When you discuss your water treatment problem with these equipment manufacturers, specify Nalcite resins to be sure of the ion exchange results you want. Nalco will cooperate fully with you, and with the equipment supplier you choose, to select the exchange system which will operate at lowest cost compatible with treated water quality required.

Copies Available

Write today for your copy of Bulletin Z-5.

Nalcite Ion Exchange Resins are manufactured by The Dow Chemical Company for Nalco Chemical Company, world's leading water treating chemical and service organization. They are available from leading water conditioning equipment manufacturers.

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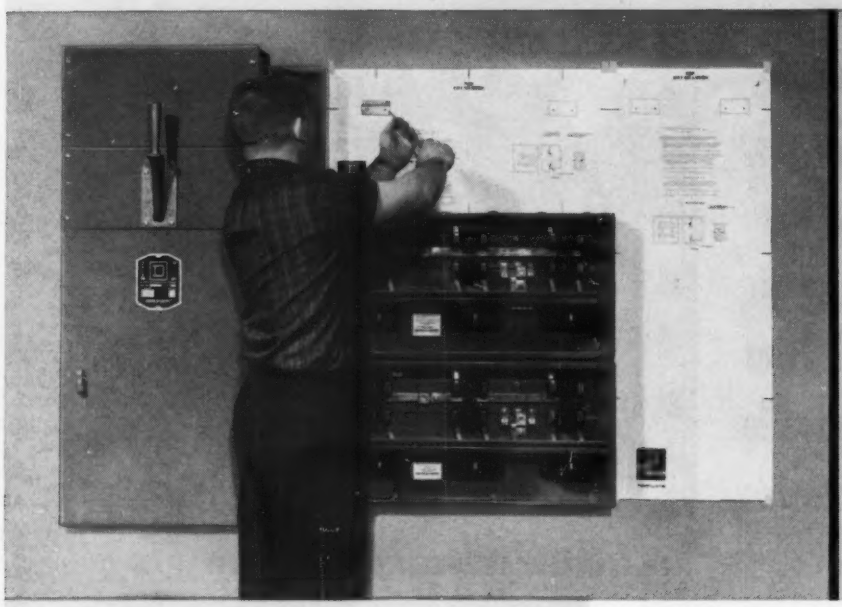
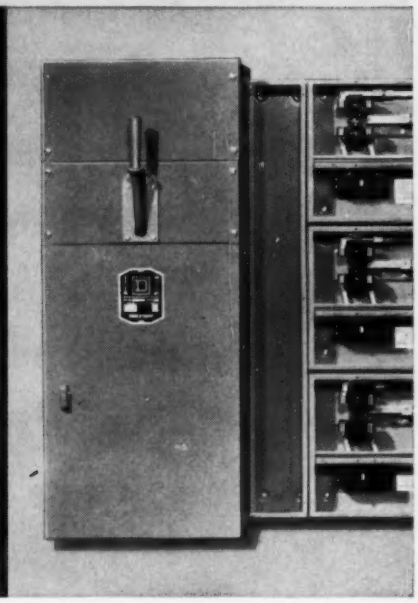
Nalco® ... *Serving Industry through Practical Applied Science*

Nalco CHEMICALS
Nalcite RESINS

new Square D E-Z STACK





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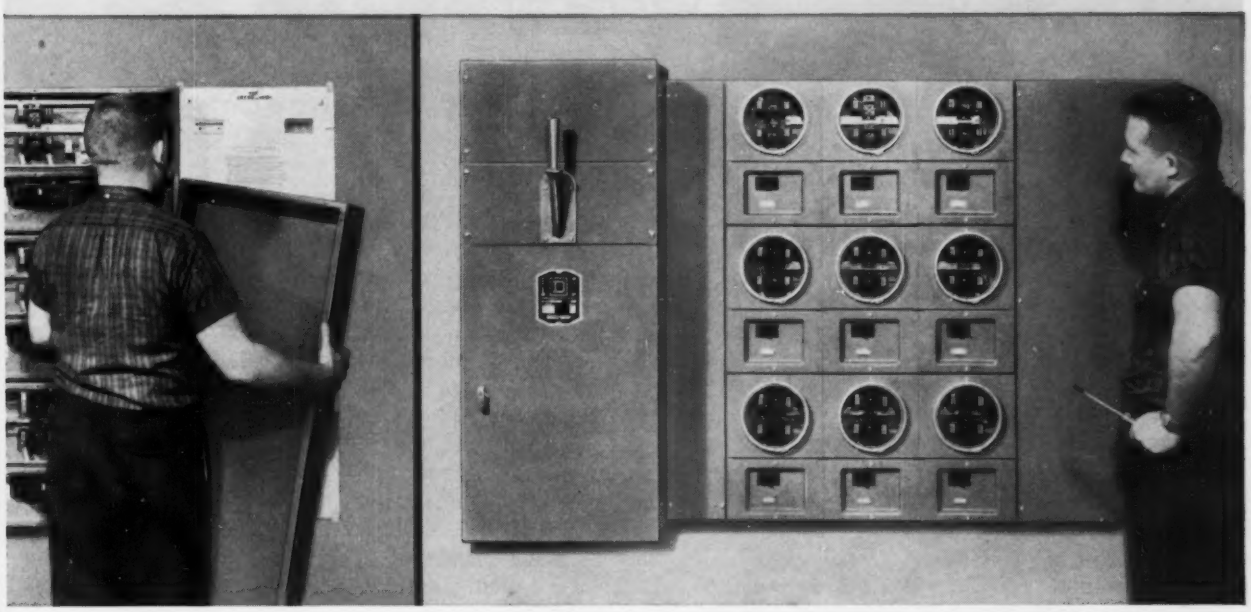
PLAN YOUR OWN ARRANGEMENT — Available wall space for the service and grouping of meters is frequently limited — and of a particular size and shape. Required locations of service and load conduits vary with each job. With E-Z STACK you have freedom of arrangement.

TEMPLATE LAYOUT — For installation convenience E-Z STACK devices include a full size template and wall mounting hanger brackets. Templates, attached to the wall, accurately position the hanger brackets for each device. Brackets on the wall interlock with clips on the back of the device.

AVAILABILITY — All E-Z STACK devices can be ordered by catalog number from authorized Square D Distributors *as they are needed.* Individually cartoned, the final decision as to the meter arrangement and size of the circuit breaker disconnect for

SQUARE D COMPANY

Apartment Metering Panels



each apartment can be determined at the Distributor's counter.

MAN-POWER — Unit assembly of the final configuration permits easier handling of all components. The wall brackets support each unit — in its proper place — while permanently securing and inter-connecting the entire installation.

WE CALL IT E-Z STACK BECAUSE — the basic meter-breaker devices easily stack one on top of the other. All devices are "meant for each other" — and bracket suspended. Knockouts in adjacent devices line up; bushings protect inter-connecting wiring. Load lug assemblies in disconnects and service entrance terminal boxes are pad-mounted in the right quantity for every E-Z STACK installation. All devices are designed for a specific purpose—multiple-metering installations.

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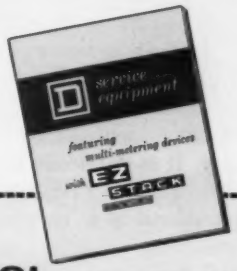

GET ALL THE FACTS! Send for new Service Equipment Bulletin No. SL-27 featuring E-Z STACK design multi-metering devices, a complete cataloging of features, specifications, suggested arrangements, and bills of material.

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From the Editor's

Tranquil Tower

The Ethics of Advertising

PARTICULARLY in matters relating to canons and codes of ethics, we are inclined to agree with Dr. Samuel Johnson that "All change is of itself an evil, which ought not to be hazarded but for evident advantage."

It is, therefore, with considerable reluctance, even with timidity, that we suggest that consideration be given to a change in an article of the Canons of Ethics for Engineers — if not in its wording, then in its interpretation. Section 2 reads, in part, "He will not advertise his work or merit in a self-laudatory manner . . ." This section has been variously interpreted, but it is generally taken to mean that an ethical consulting engineer is limited in his use of paid advertising to a small, innocuous professional card, gracelessly and tastelessly placed among a host of equally unappealing offerings — all awkwardly packed together into the inconspicuous back pages of a stodgy trade magazine.

Somewhat the same illogic reigns when one moves out of paid advertising and into the field of firm brochures. It is the firmly held faith of the professional fathers that to be dignified is to be dull; to be professional is to be plain; to be technical is to be tiresome.

Those reluctant dragons, the British consulting engineers, even argue that to be U, one must release a firm brochure only on the request of a prospective client. Using their ground rules, a press run of about 25 copies should supply the demands of a lifetime. The per copy cost of such a limited edition would make it more economical to substitute black letter manuscripts for printed pages and have them illuminated by talented monks rather than run on modern presses.

As a matter of fact, it is not so much dignity as recognition that the profession needs. It is nearly impossible to demand that the public respect a group whose purposes they fail to comprehend. Respect comes after understanding. Until the public in general and prospective clients in particular know what a consulting engineer is and what he does, dignity is likely to be interpreted as haughtiness and professional propriety as mere prudishness.

It is true that a relaxation of interpretation of this article of the canons prohibiting self laudatory advertising could appear to be an invitation to engineers to grovel in a great public orgy of bad taste. But that is most unlikely. The purchase of display advertising and the publication of attractive firm brochures are costly undertakings not lightly entered into. Few firms would purchase a page in *Fortune* or sizeable space in the *Wall Street Journal* without the advice of a competent advertising agency, and the meanest Madison Avenue man, even after his third preluncheon libation, would know better than to attempt a used car lot approach when trying to promote the use of professional engineering services.

Our argument is that consulting engineers need understanding more than they need respect. To have a prospective client know what a consulting engineer can do for him — to know when he needs an engineer — seems more to the point than a dignified demeanor.

It is also worth noting that of the 400,000 or so engineers in the country who are, in theory, guided by the Canons of Ethics, only 3 or 4 percent, the consulting engineers, are actually prohibited from advertising their businesses. All the others are free, even encouraged, to advertise their pumps and piles and piston rings, and solenoids and tacks. They are permitted to be as garish and bold as they like.

Yet, it is unethical for a consulting engineer to purchase space of equal size, in a publication of equal dignity, to conduct a factual advertising campaign that would inform prospective clients and the public of the purposes and functions of a firm of engineers in private practice.

We suggest that in a freer, fairer interpretation of this section of the Canons, there is evident advantage. We would hazard the change. ▲▲

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Insures correct dimensions, fit, and placement . . .

1. A shop drawing of the job is submitted to the customer for approval, when necessary. This plan shows the size and shape of the grating area — how grating clears all obstructions.
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more than 30 dimensional drawings of subtypes;
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"Greatest name in gratings"

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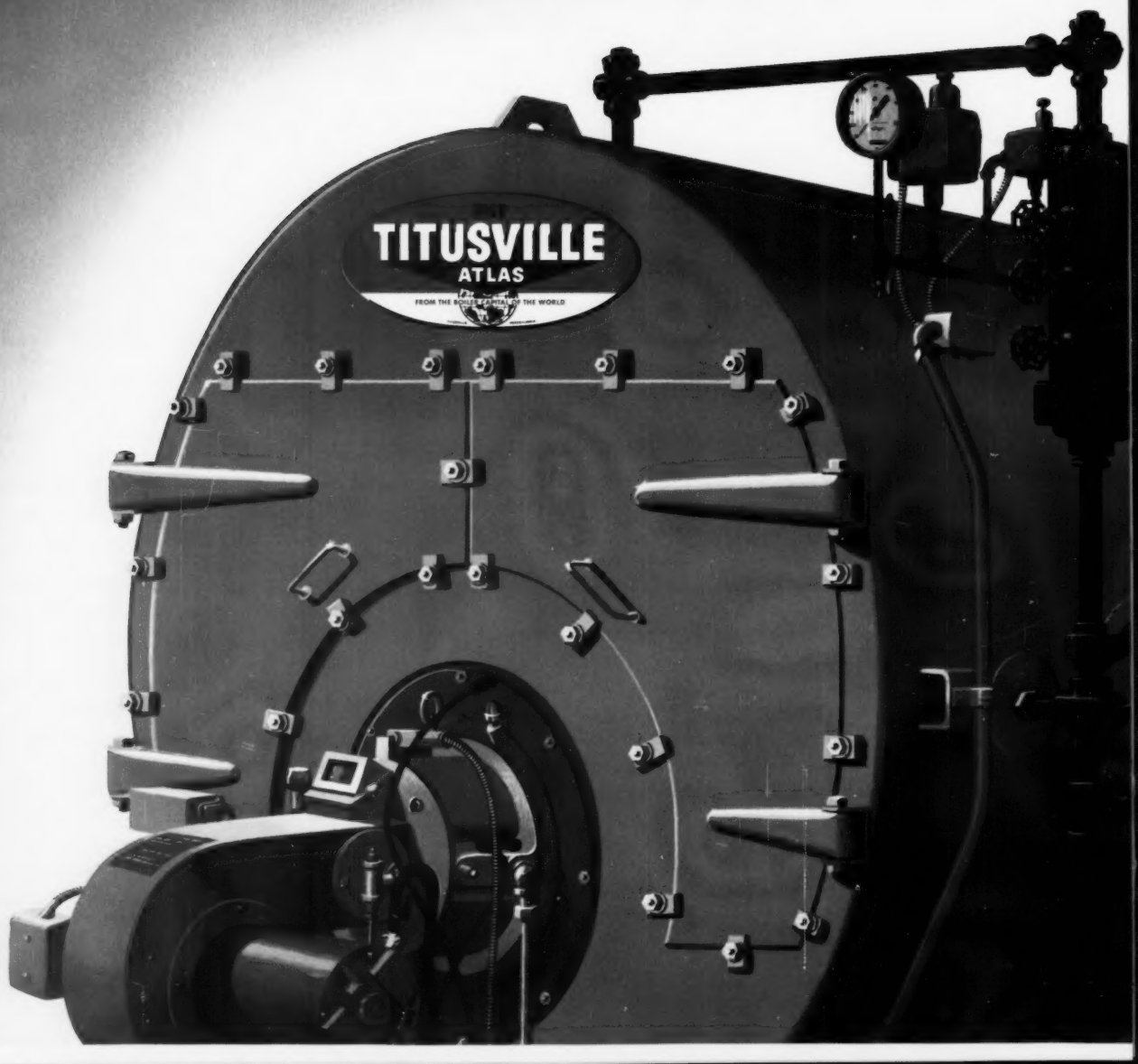

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Wet-back design gives you maintained efficiency by eliminating back end refractories. *Result:* no down time for replacement.

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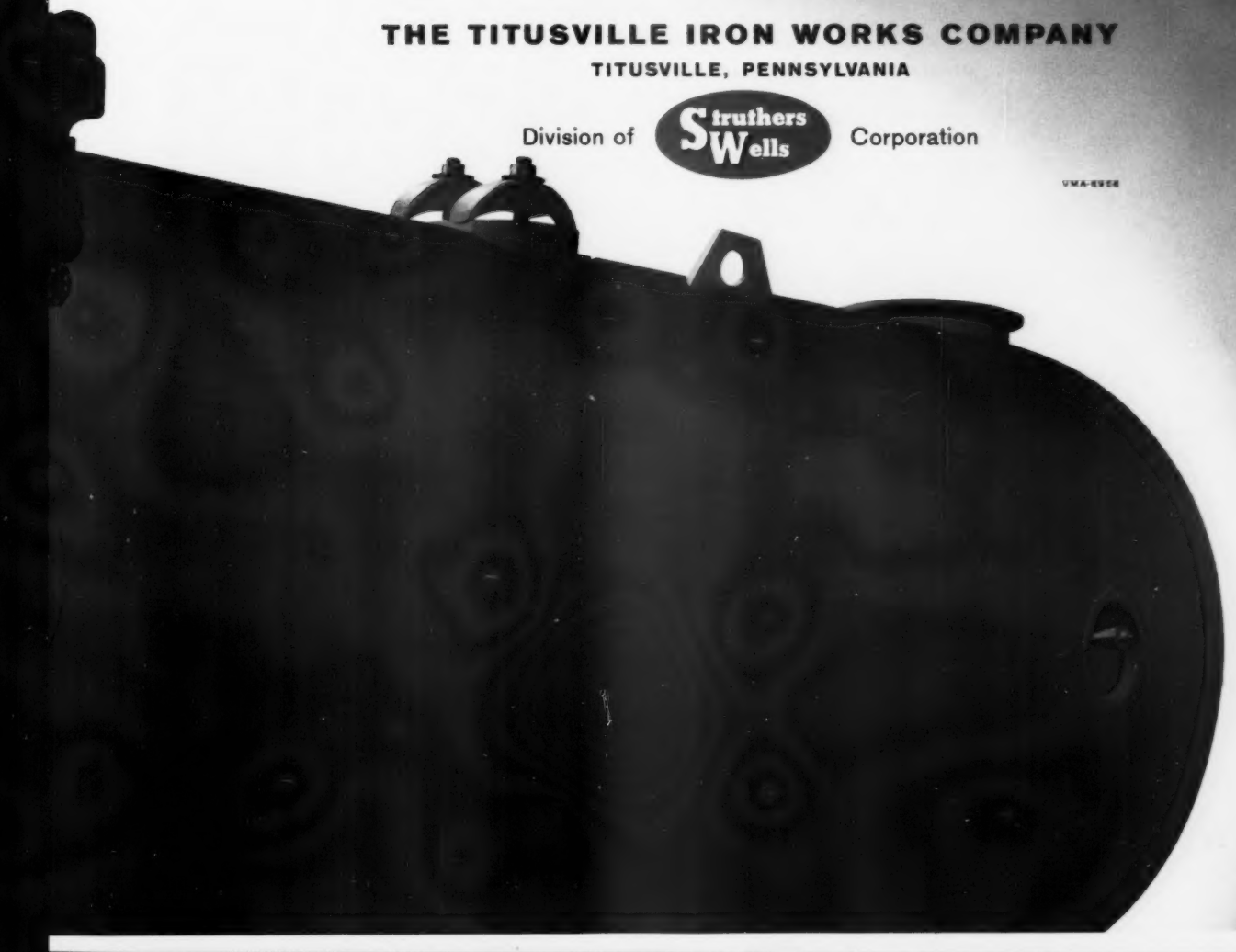

Hugh P. Duffill

— *Starts on front cover*

Typical of this approach is the way he went about organizing the Massachusetts Association of Consulting Engineers. He first heard about Consulting Engineers Council on a tour of Europe with a group of consulting engineers back in 1956. During that month abroad he had the opportunity to meet with and observe the operations of the consulting engineer associations in England, Holland, Germany, Switzerland, and France, and their international group, the *Federation Internationale des Ingenieurs-Conseils* (FIDIC). One of his fellow tour members was William Moore, of Dames & Moore, who was at that time president of the Consulting Engineers Association of California. Bill Moore had represented his association at the St. Louis meeting at which the preliminary plans for Consulting Engineers Council had been formed, and he had with him on this trip abroad a copy of the first draft of the Council's constitution. On several occasions he and Duffill discussed the proposed organization with European engineers.

NSPE and CEC

Hugh Duffill returned from Europe with enough interest in the proposed organization to attend the Council's first official meeting, in Tulsa, in July 1956. Back in Boston a few weeks later he considered getting some of his colleagues together to form a Massachusetts group, but decided against it, for he did not feel that he had all the facts. He did not want to lead his colleagues down the wrong lane, so he turned around and took a good look at another possibility, the functional group concept of the National Society of Professional Engineers, just then getting under way on a nation wide basis.

"For almost two years I read all I could about the operations of functional groups," Duffill said when interviewed last month, "and I listened to the arguments put up by those for and those against it. I have been a member of the Massachusetts Society of Professional Engineers for many years, and I am a strong supporter of it and of NSPE. The value of that excellent organization was not the question. I think every registered engineer and every Engineer-in-Training should be a member. The problem before me was whether consulting engineers also should have some business organization, not for the handling of professional affairs, but for dealing with business matters.

"I finally decided that a separate organization is required. NSPE, with a great many good members from government, industry, and education, does not have the moral right to spend the money it gets in dues from those members to promote the special interest of engineers in private practice. If I were a government employee engineer, I would fight any attempt to spend my dues money to put me out of my job and put some consulting engineer to doing my work. If I were a professor, I would yell loudly if someone put my dues to work to take away from me my moonlighting practice. If I were an engineer in industry, I would not stand still while my dues were used to keep my firm from offering engineering services as part of the equipment package.

"These engineers have a right to resist having their dues turned against them, just as the government employees of ASCE recently objected to that Society adopting a policy statement that seemed to be aimed against them and in favor of the engineer in private practice.

"Yet, I am against the expansion of government engineering departments; I do oppose unfair moonlighting; and I do not want manufacturers as design competitors. Not only that, I am willing to pay high dues and give a lot of time to an organization that can honestly support my special interest position. The position of the private practitioner is the right one, in my opinion, but I do not expect the government employees, the professors, or the sales engineers to kick in their money to support my position to their own financial detriment.

"Therefore, I am a strong supporter of the Massachusetts Society and the National Society of Professional Engineers when it comes to professional matters, matters on which the whole profession generally is in accord – registration, professional development and recognition, professional ethics, and appropriate pay for engineering employees. But when it comes to business matters – fees, who designs public works, office operations, dealings with clients and prospective clients, competitive bidding, conditions of contract, contractor relations, or interprofessional dealings – then I know we need a separate organization that does not have to straddle any fences but can get solidly on the side of the consulting engineer and stay there."

An International Outlook

Hugh Duffill has been back to Europe twice since his 1956 Consulting Engineers' Tour. He went with a similar group again in 1958, visiting London, Brussels, Paris, Milan, and Rome. In Rome he spent some time with Pier Luigi Nervi and inspected his new projects. Duffill was much impressed with Nervi's skill in forming concrete into intricate and complex structural shapes. One day, in Rome, he was telling a Roman engineer, a strong proponent of simple lines and prestressing, of his great admiration for Nervi. Finally, the Roman could take it no longer. Professional jealousy overflowed.

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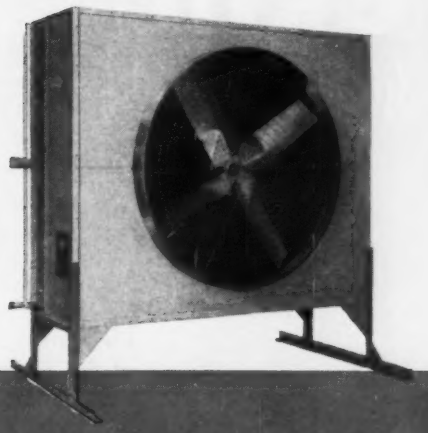

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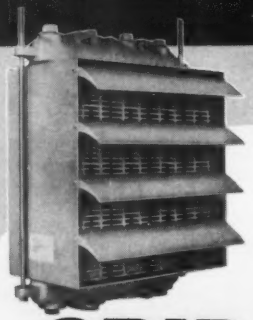

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GRID ▶ UNIT HEATERS BLAST HEATERS RADIATORS

for a trouble-free, low maintenance cost heating system - One that will serve without service - Installations made in 1929 are still operating without need for repairs. GRID'S design and construction makes the difference!

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GRID design develops low outlet temperatures and, with proper fan volumes, delivers warm, comfortable air to floor - No wasted heat at ceiling.

Get complete information on a GRID System for your plant. Write for catalog #956 GRID CAST IRON STEAM HEAT TRANSFER SURFACE.

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"Nervi, Nervi, Nervi! Everybody talks about Nervi. Nervi is a mud molder. He designs in mud; he works in mud. Nothing that Nervi knows but mud, mud, mud!"

His latest trip to Europe took him to Amsterdam, where he attended last year's FIDIC meeting as a member of Consulting Engineers Council. By that time, he had decided the Council concept was right, and he had become a member-at-large, but it was not until he got back from this trip that he was so sure of his decision that he set about organizing the Massachusetts Association of Consulting Engineers. It had taken him a long time to hear all the arguments, but once his decision was made, it took him no time to get on the phone, pick a group of colleagues, set a meeting date, and get under way. He knew all the problems and all the answers that had been used. The Massachusetts Association came into being with less fuss and foolishness than any such group on record.

This past May, Duffill went to Oregon to the Annual Meeting of the Consulting Engineers Council and officially took his seat on the Board as the Director from Massachusetts, the Council's thirtieth Member Association.

"Heading an association that is a member of the Council," Duffill points out, "does not mean that I am no longer interested in NSPE. I even agree that the functional group idea is worthwhile if we are talking about a discussion group or an opportunity for us to put our ideas before engineers as a whole and before employees as well as employers. I went right to work, as soon as I got back from the Council meeting in Oregon, planning the Functional Group program for the National Meeting of NSPE, in Boston, in June. I served as program chairman for that meeting, and it turned out to be a good one. I am particularly impressed by the obvious stature and ability of L. M. Van Doren, of Kansas, the new national chairman of NSPE's Private Practice Functional Group."

Highway Committee Activities

Shortly after Massachusetts joined the Council, Duffill was appointed chairman of its Highway Committee. That was an appropriate appointment, for Duffill Associates has designed many miles of highway in New England, and Duffill is, himself, fully familiar with the highway policies in his own state. Massachusetts has the kind of state highway department consulting engineers like. It is small, well run, knows what it wants, and uses consulting engineers for design of all but the smallest and most routine projects. Relations between consulting engineers and the State Highway Department, the Turnpike Authority, and other government groups handling public works are excellent.

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EXCLUSIVE

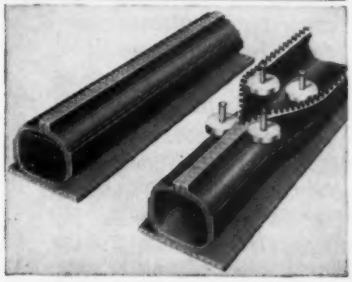
"ZIPPER"* CLOSED-BELT CONVEYOR-ELEVATORS

LOADING AND UNLOADING CYCLE OF "ZIPPER" CONVEYOR

1. Sidewalls brought into vertical position and ready for loading.

2. Flexible tube completely closed for conveying and elevating.

3. Rubber ZIPPER belt open for discharge, cleaning and return run.



Upper left unit closed and loaded. Lower right shows how belt is opened and closed by system of ball bearing rollers. (Rollers are mounted on a rigid framework)

CONVEYS AND ELEVATES BY CONTINUALLY WRAPPING MATERIAL IN A PACKAGE... MOVING THE PACKAGE AND ITS CONTENTS TO A NEW LOCATION AND GENTLY UNWRAPPING IT!

Literally a moving material-carrying conduit, the ZIPPER Conveyor is capable of transporting bulk materials in any plane, to considerable heights and around obstructions. Its great advantage is that bulk materials may be conveyed within the belt completely sealed and dust-tight. Material doesn't slide, isn't scooped, pushed or thrown but is gently carried over great distances without breakage, agitation or segregation. The ZIPPER Conveyor-Elevator provides versatility of layout and profitable material handling advantages you won't want to overlook.

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WRITE FOR BULLETIN 349

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So SIMPLE that "Specials" are Likely to be Standard!

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The World's Most Dependable

LIQUID LEVEL CONTROL

Because of the utter simplicity of Magnetrol's magnetic operating principle, standard models can be easily adapted to meet any special requirements for pressure, temperature or corrosive liquids . . . and usually at little extra cost. This Magnetrol versatility has solved all kinds of tough level control problems . . . and given our engineers wide application experience that can be invaluable to you.

Magnetrol is so simple that failure is all but impossible! Using only permanent, unfailing magnetic force for its operation, there's nothing to wear out . . . no diaphragms or bellows to stiffen and rupture . . . no electrodes to short or corrode . . . no packing to bind or leak. Magnetrol is practically maintenance-free! Magnetrol units are available for controlling level changes from .0025-in. to 150-ft. . . . with multi-stage switching when desired. Send coupon for full details.

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For the most part, these groups take the position that they get the most for the public money by using private firms for design of public works.

This near-ideal condition was not brought about, according to Duffill, by public accusations, the flinging of cost figures into bureaucratic faces, or the pulling of special strings by lobbyist groups. Instead, he thinks that most public officials can be sold on the use of consulting engineers by using the same good sales tactics used in convincing a private owner that he should use a consulting engineer. Of course, the fact that Duffill worked for the Illinois Division of Highways for many years after his graduation from M.I.T. gave him an opportunity to learn the state engineer's viewpoint and to appreciate his understandable pride of accomplishment.

"You would not get far in selling your services to a private industry if you condemned their engineering department for its inefficiency and waste and called any man who refused to use your services a communist. When dealing directly with a public official, you must court him just as you would if he were a private owner. You must go through your story, show him what you have done in the past, convince him of your ability, and make clear that his having selected you to do the work will reflect to his credit when the job is complete. Surely this type of approach is going to get more work for consultants than the use of angry recrimination and political scheming.

Action Through Common Interests

"Treating the public official just as you would any other client is only part of the battle. Naturally, when you get into a public political fight, you have to tell your side of the story and tell it strongly. Again, though, there is plenty to tell positively about the consultant without wasting too much time tearing down government engineers. For example, one day last December, I picked up the morning paper and found that consulting engineers in Massachusetts were being criticized for being awarded public work without competitive bids. This, according to the paper, was a scandal. I got on the phone, got a promise of $4000 from five other members of the newly formed Massachusetts Association, and we immediately got hold of an agency and prepared an advertisement that we inserted in both the morning and afternoon papers. The ad explained to the public the role of the consulting engineer and showed why competitive bidding would be wrong and wasteful. I do not know how much good it did with the public, but certainly our public officials read it, and the newspaper people saw it. Since that time no government agencies in this area have called for competi-

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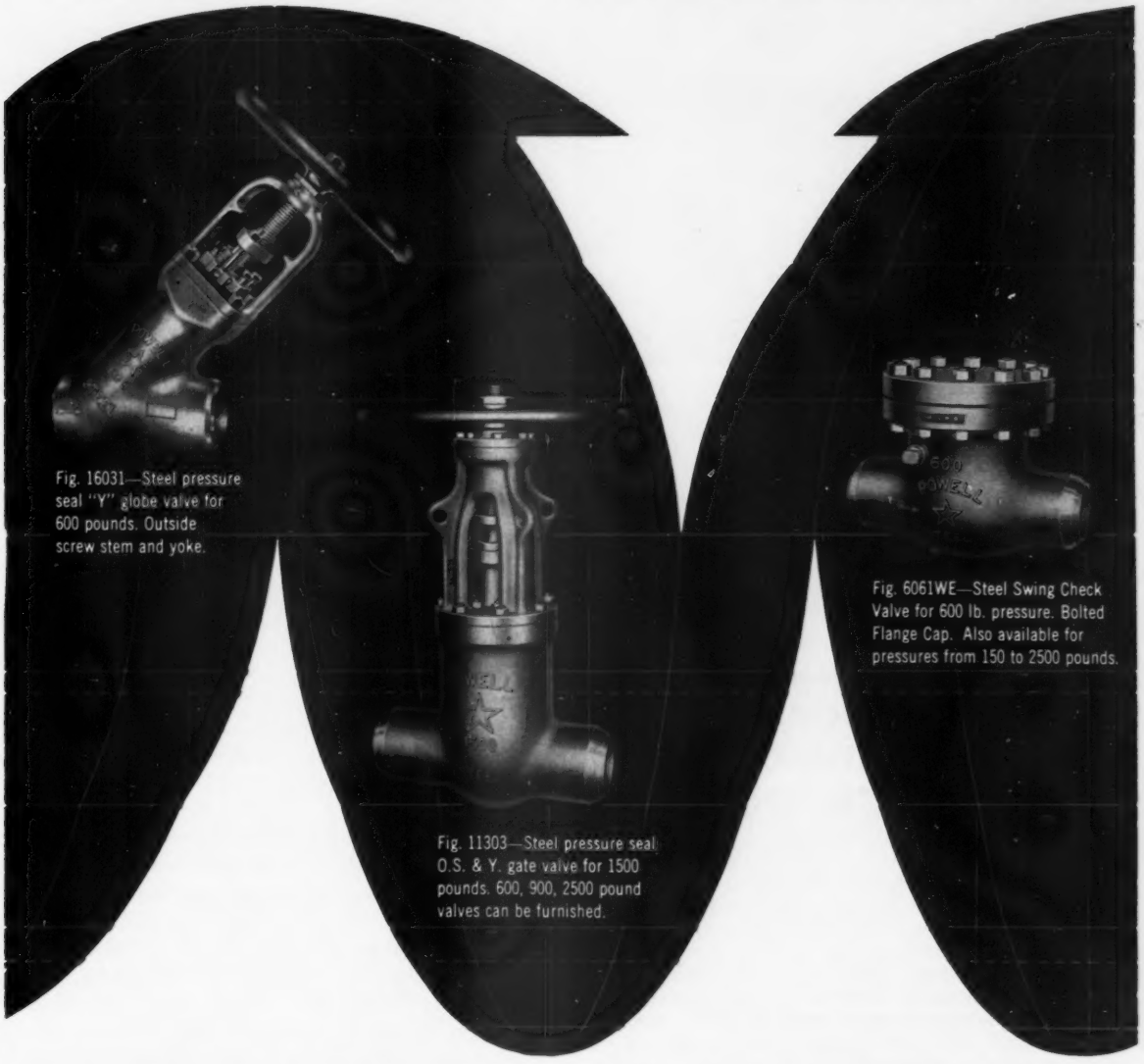

Fig. 16031—Steel pressure seal "Y" globe valve for 600 pounds. Outside screw stem and yoke.

Fig. 11303—Steel pressure seal O.S. & Y. gate valve for 1500 pounds. 600, 900, 2500 pound valves can be furnished.

Fig. 6061WE—Steel Swing Check Valve for 600 lb. pressure. Bolted Flange Cap. Also available for pressures from 150 to 2500 pounds.

—and you can be sure of proven PERFORMANCE from Powell Valves—valves which, because of design, engineering, construction, are depended upon to control mounting pressures and temperatures in conventional and atomic power plants all over the world . . . and in modern industry. Performance is high—maintenance is low.

Gate, globe, angle, check, non-return and "Y" steel valves are made in all commercial sizes . . . for pressures to 2500 pounds and higher . . . for temperatures from sub-zero to super heat.

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Powell . . . world's largest family of valves

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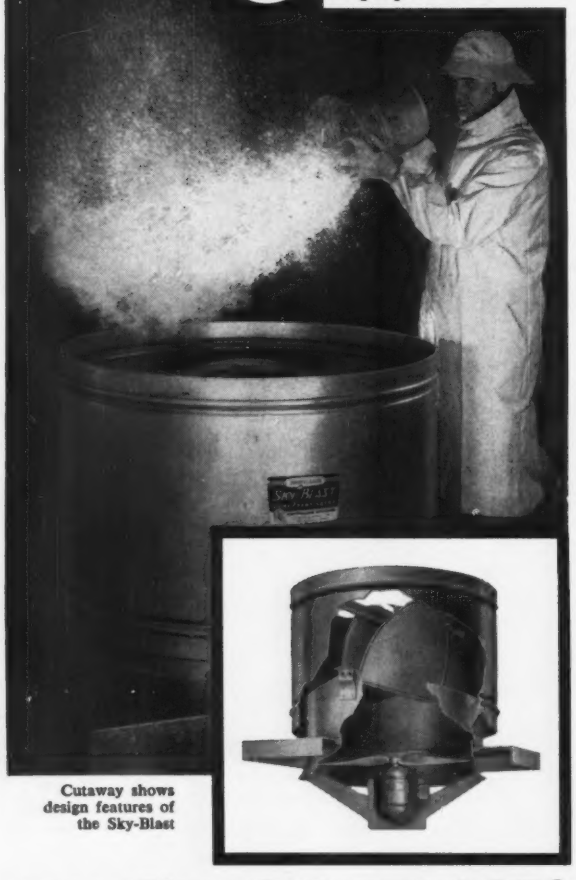

Cutaway shows design features of the Sky-Blast

Free-Flow SKY-BLAST® Roof Ventilators are WEATHERPROOF!

Even if the rain comes down in buckets, there's no need for weather covers on SKY-BLAST roof ventilators. In operation, the powerful airstream keeps out snow, rain and sleet. At rest, butterfly dampers form a water-tight seal, won't leak a drop. With no interfering covers, more air is moved at less cost. Fumes are thrown high in the air to prevent re-entry into the building and to eliminate roof maintenance problems created by other types of ventilators. Wind velocity or direction can't affect performance. Heavy gage steel surfaces are hot-dip galvanized for real sou'wester protection. With patented, non-clogging rainshed, low wind guard, rugged base and condensate drain, it's always fair weather beneath a SKY-BLAST. Wind tunnel proven ratings to 78,000 cfm. Send for bulletin 680—CE

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MOVING AIR IS OUR BUSINESS®

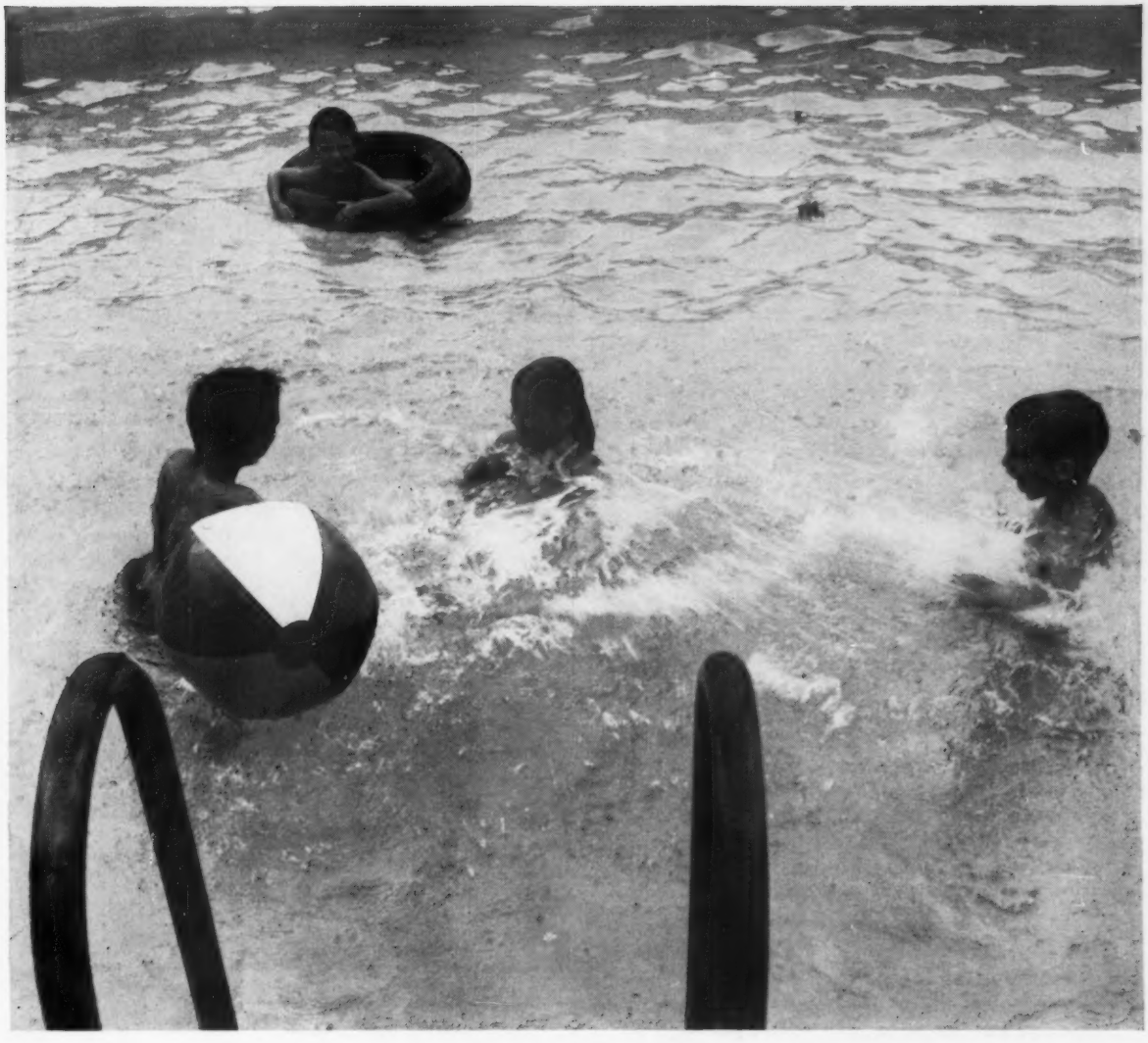
tive bids for engineering nor have any newspaper reporters carelessly called negotiations "bids" in their stories. They seem to know the difference now, and the reasons for the difference.

"Even in this public controversy in which the original news story had recommended greater use of government engineers and reduced use of consultants, we did not say a word about bad or expensive engineering by government engineers. Instead, we concentrated on the highly competent, efficient services that are offered by consulting engineers. We hit hard and we hit quickly, but we took a positive approach.

"One of the most interesting aspects of that little action was the rapidity with which it was handled. It was financed by a few quick phone calls and a check with the executive committee of the Association. That ad would never have been placed, or certainly it would have had to wait for weeks and have undergone all manner of emasculation, if we had been acting as a Functional Section of the Massachusetts Society of Professional Engineers. At the very minimum, the board of directors would have had to approve, and most of them are not in private practice. This is an example of the kind of business project that demands action through an organization whose membership is limited strictly to the owners and principals of firms of engineers.

"We understand, of course, that one newspaper advertisement does not provide any permanent solution. We stand ready to act again just as fast as a situation calls for it. In fact, we may even practice a little preventative war and take action if we think we see trouble ahead.

"At the moment," Duffill continued, "consulting engineers are doing rather well in getting the major share of public work in this part of the country. As chairman of CEC's Highway Committee, I am going to have to do what I can to spread our success across the nation. I am not so foolish as to think that kind words and a good sales talk are going to change the state constitution of California so as to permit the extensive use of consulting engineers on highways or on public buildings. The civil service lobby in California is an awesome operation. It makes the big Federal employee organizations look about as politically powerful as a Stanley Party. But even there, whatever may be gained is not to be gained through calling the highway director names or pointing to purportedly high cost design work by state highway engineers. After all, we are not trying to underbid them, are we? We are supposed to be against getting work on a price basis, are we not? Let us simply sell our superior talents and our flexibility of operation. We can do a better job, faster; then we can get



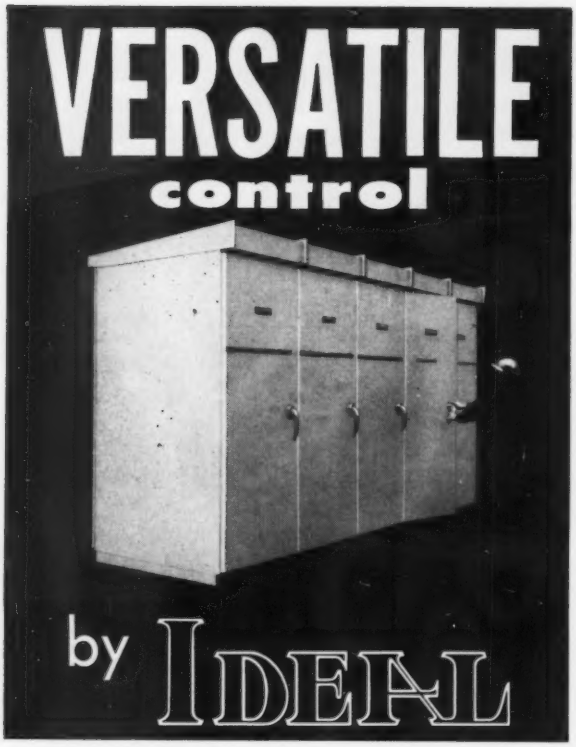
here's why leading engineers specify Bruner pool filters:

exclusive features: Bruner's plastic disc core septum, "Air Bump" and "Air-Vac" systems add to the life of the filter, increase filter run, and speed cleaning operations. All three are Bruner exclusives.

proven quality: Bruner pool filters have been field tested for years under all water conditions, are backed by Bruner's reputation for dependability.

custom-tailored: In addition to providing filters out of stock, Bruner can tailor filtering systems to fit your exact needs. For more information contact your nearest Bruner Sales Office or the Bruner Industrial Sales Department.

BRUNER Corporation
4767 North 32nd Street, Milwaukee 9, Wisconsin
DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.



Over half a century experience in the electric motor field has provided Ideal with the design and engineering background to solve any control problem. Custom-designed to individual specifications with the advantages of a number of exclusive features pioneered and developed by Ideal engineers, Ideal equipment is a sound investment for lasting service and protection.

Typical of hundreds of basically similar weather-protected units in use throughout industry, the above control, installed at a large mid-western oil company, houses two large synchronous motor starters, two smaller induction motor starters, two starters for excitation rectifiers, one 230 to 440 volt auxiliary power transformer, a 440 volt distribution panel and a 110 volt lighting and distribution transformer. For other examples of synchronous, wound rotor and squirrel cage induction starters and controls for indoor and outdoor use, or assistance in selecting the exact control for your requirements, write for Bulletin 601 or contact your nearby IDEAL representative.

The
IDEAL ELECTRIC
& MANUFACTURING COMPANY
347 East First Street Mansfield, Ohio

out (without having to be pensioned out) and can come back when needed next.

"That is the story that I would like to see the engineers in every state sell to their highway directors and highway engineers. It may not be an easy job, but it will get us further than screaming at public officials, or bemoaning our "socialistic economy," or testifying against our clients.

"So, as CEC's Highway Committee Chairman, I am going to try to find ways to change this fight into the friendly client-engineer relationship it should be.

"Consulting engineers have always enthusiastically endorsed any statements by prominent figures, such as Robert Moses, who argue in favor of a system using a few competent, well paid top public officials doing public works planning; with design and supervision then being done by consulting engineers. But consultants seem to read only the last part of the statements. They feel no responsibility for the first part – getting the high pay for the few top men. How many consulting engineers have made any effort to get better ratings and higher pay for qualified public officials? Currently, the only way a state highway department man can make more money is to expand his department, get more men under him, and thereby raise himself up in the time tested bureaucratic method.

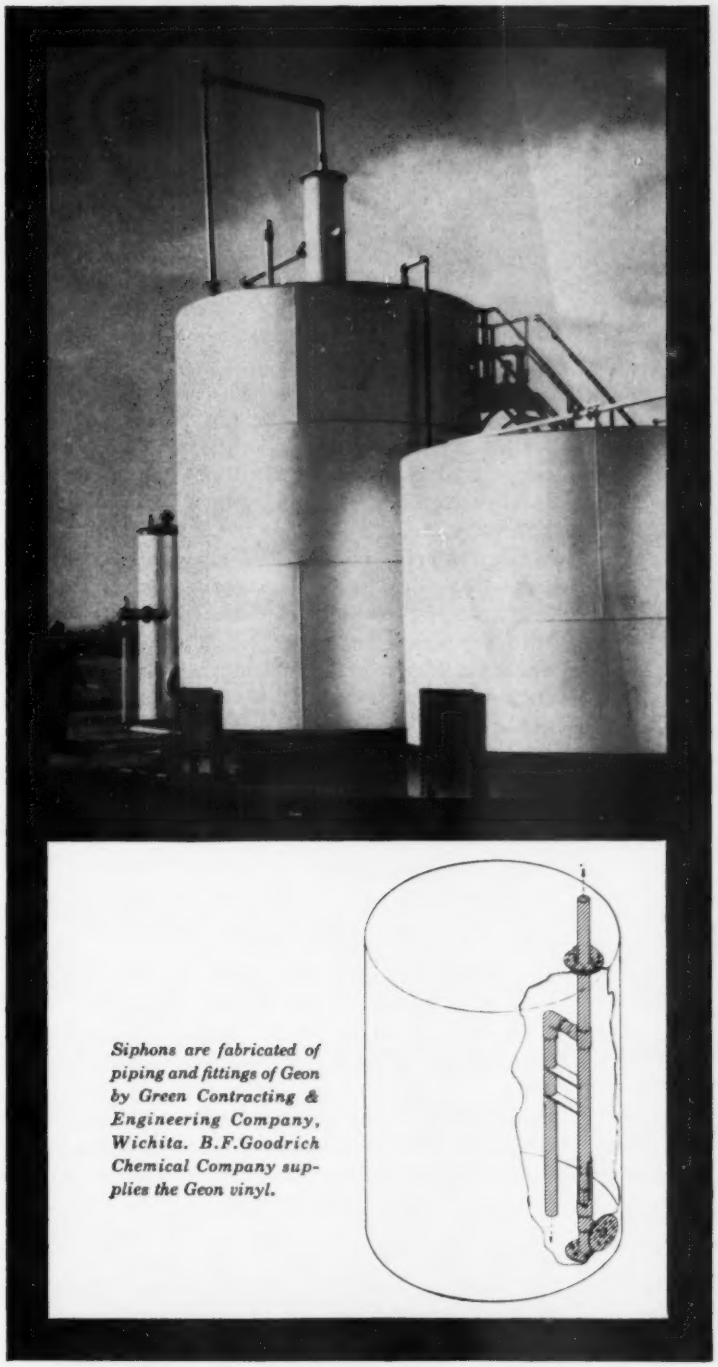
Promoting Public Employees

"We might be surprised at the reaction if we were to get to work as state or regional associations and put up a strong fight for higher salaries for the really good men in government, the clients we like to deal with, so that they get paid for their talents and for their efficiency. We would not hesitate for a moment to say a good word for a competent plant engineer in an industrial operation, a man who worked with us and cooperated on a project. We would all happily go to his boss, our client, and tell him what a fine man he had working for him. In contrast, how many of us have recommended a raise for a government employee? How many of us have talked to a legislator in an effort to get more money for some top man in a government engineering department? How many state or regional associations have had as part of their program a plan to not only reduce the size of government engineering departments but also to raise the pay of those responsible men at the top?

"A few weeks ago, as chairman of the Highway Committee, I attended a meeting in Washington with representatives from a number of other national engineering societies. We talked together all morning and all afternoon, and we had lunch with top men of several Federal engineering departments – the Bureau of Public Roads, the Bu-

Another new development using

B.F.Goodrich Chemical *raw materials*



Siphons are fabricated of piping and fittings of Geon by Green Contracting & Engineering Company, Wichita. B.F.Goodrich Chemical Company supplies the Geon vinyl.

Siphon separates oil from brine —no corrosion

it's made of GEON

Either the oil or the salt water in these oilfield gathering tanks in Kansas can make short work of ordinary pipe. Now, with pipe and fittings fabricated of rigid Geon vinyl, there is no corrosion problem at all. Geon solved another problem too: the buildup of paraffin, common in metal pipe, was eliminated.

Geon pipe proves ideal for a wide variety of applications because of its resistance to corrosion and its impact and tensile strength. Crews especially like its light weight and easy installation. Either solvent welding or threads can be used.

Here's another example of the way that Geon vinyl solves product problems—and opens new markets. For more information, write Dept. GI-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

EXTRA STRONG . . .
BETTER LOOKING . . .
LIGHTER WEIGHT!

Exclusive swaging and forming process prevents cross bars from turning, twisting, coming loose or falling out . . . provides greater strength and rigidity than gratings using obsolete methods of joining bars. Only Gary Galok Aluminum Gratings offer all these advantages:

High strength to weight ratio. Minimum deflection . . . easier to install.

Non-rusting and corrosion resistant. Ideal where chemical conditions prevail.

Can be used for decorative purposes, sun-shades, grilles, etc. Can be anodized in sunfast colors to blend with surroundings.

Available with serrated or plain bars—in all sizes to meet practically every requirement.

*Patent Pending

Write for Bulletin
Dept. J-7 E. Seventh Ave., Gary, Indiana

ROCKWELL-STANDARD CORPORATION
Grating Division, Gary, Indiana

reau of Yards and Docks, the Corps of Engineers, and the Department of the Interior. I do not think we accomplished much, and I am certain that we did not change any Federal policies having to do with the use of consulting engineers. But it is a good idea for each of the societies to know what the others are doing – if anything. And it is true, again, that the way to change policies on this Federal level is the same as it is back at the state house or the city hall. We have got to get to know all these people and sell them our services."

Duffill Associates

Duffill's efforts to sell private practice to public officials has worked for his own firm. He has been in private practice since 1948. The first three years were in partnership with an architect in the firm of Drummey and Duffill, but he bought out Drummey in 1951, and since that time has concentrated on public works. His practice has rapidly expanded, and in 1959 the firm had its first million dollar billing year. A considerable portion of this represents fees for highway work, but Duffill Associates has also been engaged in shore and beach protection.

Hugh Duffill, himself, has been interested in coastal engineering for many years. His service as a Commander in the Coast Guard during the war, when he was in charge of that Service's activities in Boston Harbor, increased his interest in coastal engineering. In recent years his firm has done much of the State's work in this field. On his first visit to England, while many of the group were seeing the usual tourist attractions of London, Duffill was studying the built up beaches, the groins, and the breakwaters of the Channel Coast. The Netherlands fascinated him as one great example of the finest in coastal work. Last year he added to his staff Hungary's distinguished hydraulic engineer, Attila M. Bené (who has just returned from the Hague, where Duffill Associates sent him to attend a conference on Coastal Engineering).

Duffill also calls on Dr. Per Bruun to work with him, when he feels the professor's unusual talents are needed. Bruun is head of the world renowned Coastal Engineering Laboratory at the University of Florida, and he is generally recognized as the outstanding authority on coastal engineering. Several months ago, Duffill visited the Laboratory at the University of Florida and was much impressed by the work they are doing. When he returned to his office, he contacted Colonel Graling, secretary of the American Shore and Beach Preservation Association (Duffill is on their board of directors), and offered to finance a $2000 annual fellowship for graduate study in coastal engineering.

Hugh Duffill has two associates in his firm. Alice M. Adams, a civil engineering graduate and

Here's How KENNEDY'S Union Bonnet and Hex End Design Give You Easier Installation, Longer Valve Life...

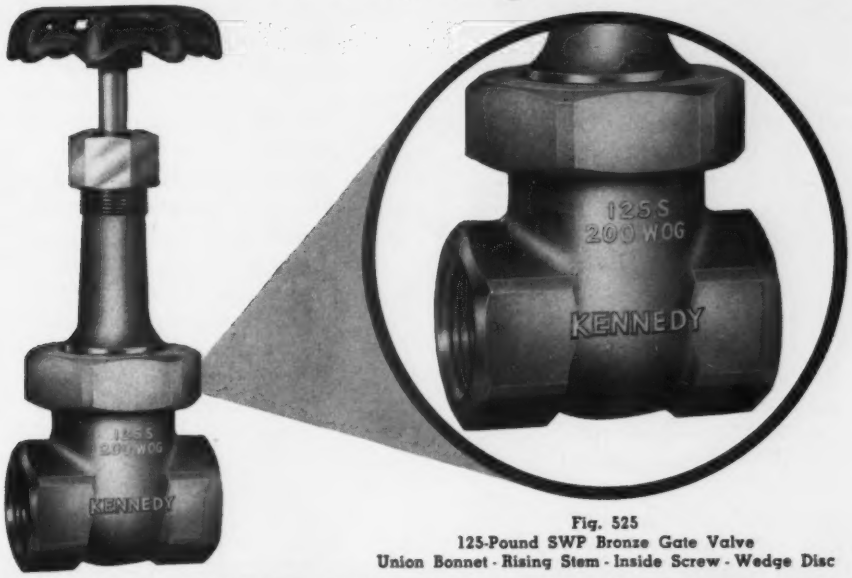
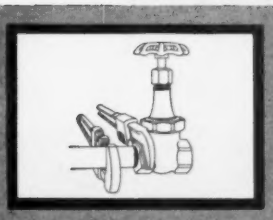
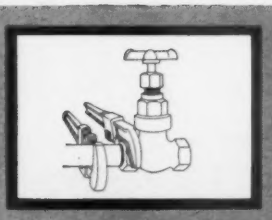


Fig. 525

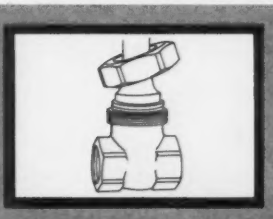
Fig. 525
125-Pound SWP Bronze Gate Valve
Union Bonnet - Rising Stem - Inside Screw - Wedge Disc



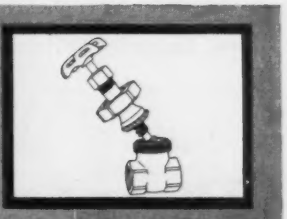
KENNEDY'S wider hex ends are blended into the body, making the body and hexes one rugged unit. Thus extreme wrench pressure is absorbed through the entire rigid valve body.



On conventional valve body, hex ends protrude from the body and are connected by thin body wrists. This area, under severe wrench pressure, can distort and cause disc seating trouble.



Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion to the valve. The bronze-to-bronze construction makes a tight union for tight, leak-proof operation.



Union Bonnet Fig. 525 can be easily disassembled into its component parts to installation in otherwise inaccessable places in existing lines or in new installations where space is limited.

These additional advantages make KENNEDY your best valve buy...

Heavy Bronze Union Bonnet Ring is entirely separate from the bonnet to eliminate any possibility of springing the bonnet face when assembling or disassembling the valve.

Cylindrical Body withstands sudden pressure. Kennedy's Cylindrical Body construction resists rupture and minimizes deflection when under severe pressure. Pressure in ordinary valve bodies tries to push the body wall out. Rupturing stresses concentrate where wall has the shortest radius. This deflection causes early failure in ordinary valves.

• *YOU CAN'T BUY A BETTER VALVE THAN A KENNEDY!*

KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS

• OFFICES AND WAREHOUSES IN NEW YORK, CHICAGO, SEATTLE, SAN FRANCISCO, ATLANTA • SALES REPRESENTATIVES IN PRINCIPAL CITIES •

registered professional engineer, is treasurer. Andrew Christo, vice president, is a registered civil engineer, with a B.S. and M.S. from Northeastern University. He was formerly an employee of the Massachusetts Department of Public Works and has been with Duffill Associates since 1955.

New Offices Boost Employee Morale

In May of this year, Duffill Associates moved out of their old and fairly dreadful offices to new quarters across Kenmore Square. The new offices are as plush as the old were dingy.

"Somehow I felt we were being hurt by our old surroundings. I think that a staff tends to match their work to their environment, and the cluttered, bedraggled old office encouraged cluttered, bedraggled thinking. The physical environment always influences the work habits of employees. Whether they are conscious of it or not, they react to their surroundings. The employees can scarcely be expected to turn out neat and well conceived work when stationed in an environment that reeks of carelessness and indifference.

"So, as soon as we could afford it, we moved into new offices, and we hired good interior decorators and bought the best new office equipment. It has worked wonders with the employees, and I cannot deny that it has even affected me and my partners. True, we seldom have a client in to see us, but when we do, we look like a respectable, responsible organization, and now, when a set of drawings goes out, a little more pride goes along with them."

"Our new environment (or perhaps it was our first million dollar year) has inspired us to hope for continued expansion. Up until now we have stuck closely to public works, but now I am interested in diversification. I am looking for private clients, too, though I certainly would not go back to interprofessional work.

"We are interested in expansion geographically, too. Almost all of our work has been in New England, but now I am looking for foreign projects. I think there is a great future for American consulting engineers in Africa, the Middle East, Asia, and South America. I also think that there are certain aspects of the Common Market now developing in Europe that will mean opportunities for American consultants. To compete in that market, American manufacturers are going to have to build factories inside the Common Market area to avoid tariff barriers and quota restrictions. New plants for American manufacturers in Europe should mean the use of American consulting engineers' services – if we are good enough salesmen.

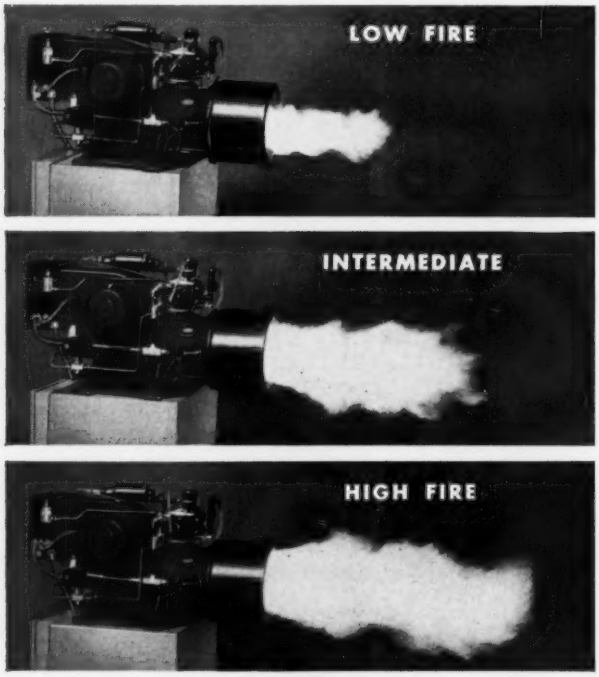
"The opportunities are everywhere – it is just a question of how we respond to them." ▲▲

Burner does a slow burn

for smooth, economical operation

HEV-E-OIL BURNERS start with a low fire, a small flame which gradually builds up to the required size for safe, smooth operation. Low fire and high fire are controlled exactly to assure top efficiency over the entire firing range. Moreover, Hev-E-Oil burners furnish all the primary and secondary air needed for efficient combustion. Available from 5 to 150 gph. Also combination gas/oil burners from 720,000 to 21,000,000 Btu.

HEV-E-DUTY POWER GAS BURNERS also utilize slow fire build-up for top performance. Air is metered in correct proportion to the amount of gas being used, resulting in high efficiency regardless of chimney draft caused by outside weather conditions. Sizes from 720,000 to 21,000,000 Btu. For more information on Hev-E-Duty Power Gas, Hev-E-Oil and combination burners, write Dept. CE-100.



INDUSTRIAL COMBUSTION INC.
EXECUTIVE OFFICE: 4507 N. OAKLAND AVENUE
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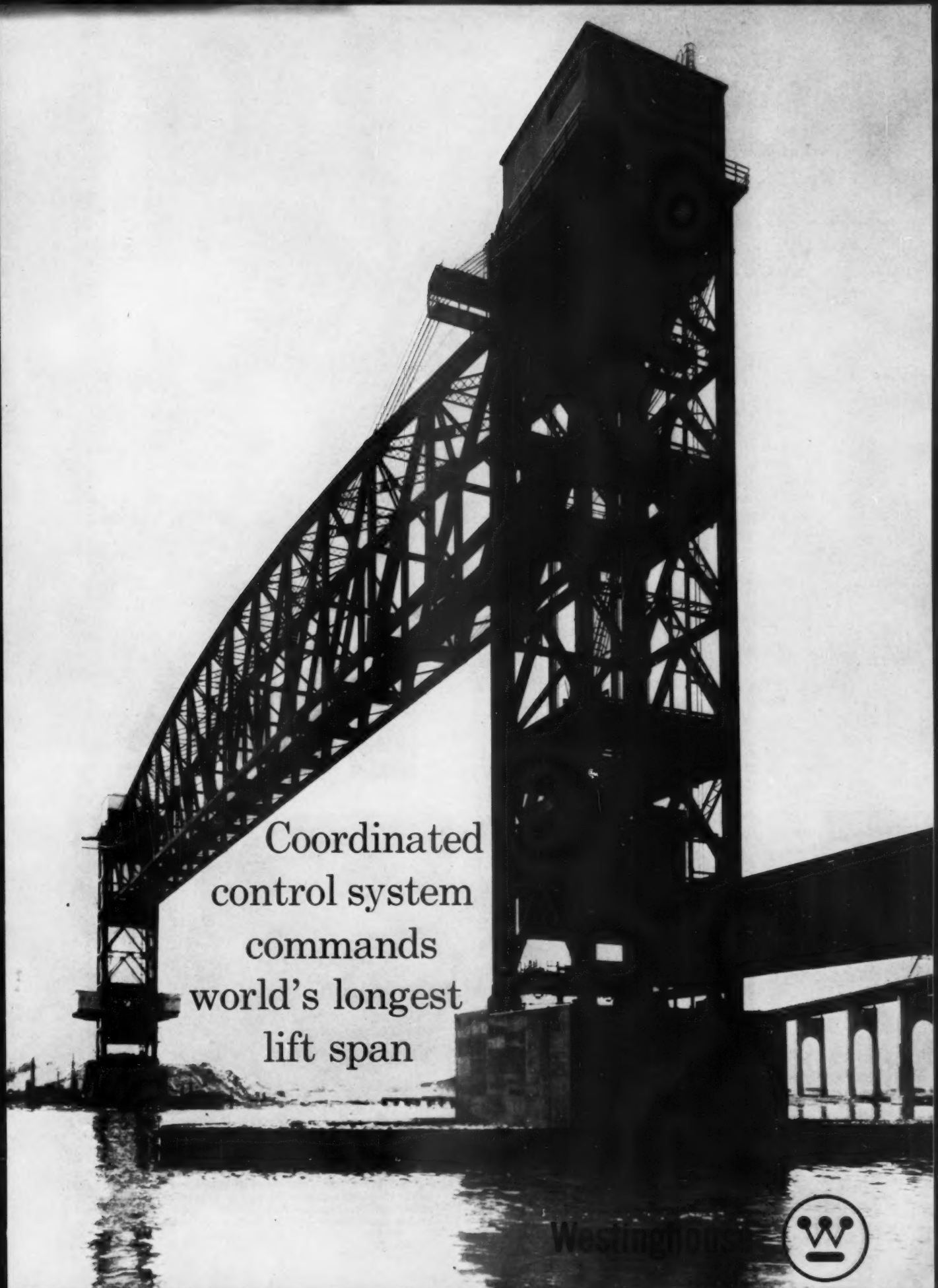

Coordinated
control system
commands
world's longest
lift span
Westinghouse

ON COVER: The Arthur Kill Lift Bridge between Staten Island, N. Y., and Elizabeth, N. J., was designed by Parsons, Brinckerhoff, Quade & Douglas for The Staten Island Rapid Transit Railway Company (a wholly owned subsidiary of The Baltimore and Ohio Railroad Company) and built by American Bridge Division of the United States Steel Corporation. 1645 feet long over-all, the bridge is shown with its 558-foot central span in raised position.

Westinghouse electrical system gives precise, reliable control over vertical lift of 2,000-ton span

The new Arthur Kill Bridge boasts the longest vertical lift span ever constructed. The record length span replaces an old swing bridge whose center pier had become a navigational hazard. Westinghouse equipment quickly and smoothly elevates the span 104 feet to leave a 500-foot-wide clear navigation channel for the passage of ships—lowers the span for rail traffic.

Suspended between two shore towers, the counterweighted main span is operated by giant cable sheaves driven through reduction gearing. Measuring 558 feet in length and weighing four million pounds, it can be raised or lowered through its 104-foot travel in approximately two minutes. The d-c adjustable voltage drive, furnished by Westinghouse, gives precision speed control and holds skew of the span to a minimum throughout the normal operation cycle.

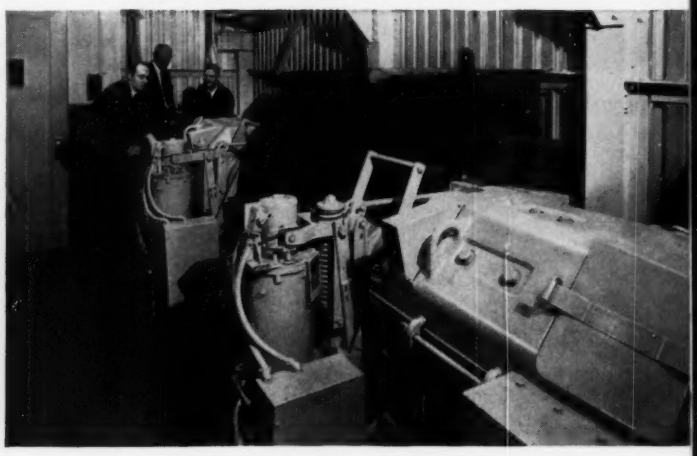
Smooth acceleration to maximum speed and gentle controlled retardation to stop give the bridge every assurance of a long and useful life with a minimum of maintenance. Standardized d-c mill motors furnish drive power for span operation. Heart of the precision speed control is the Westinghouse Magamp exciter regulator. This simplified design uses the completely static Magamp and a single field rotating exciter to provide top performance with extremely low maintenance.

Drives in each tower are synchronized by a sensitive skew detection scheme which uses static elements to automatically reduce voltage to the leading motor and increase voltage to the trailing motor. This system can be expected to keep the two ends of the lift span within close limits of being perfectly level throughout its travel. To assure bridge operation under emergency conditions, a stand-by diesel engine generator set is installed. A duplicate drive system is also provided and is available at the option of the bridge operator at any time. *(cont'd)*

J-94150-A2

Westinghouse

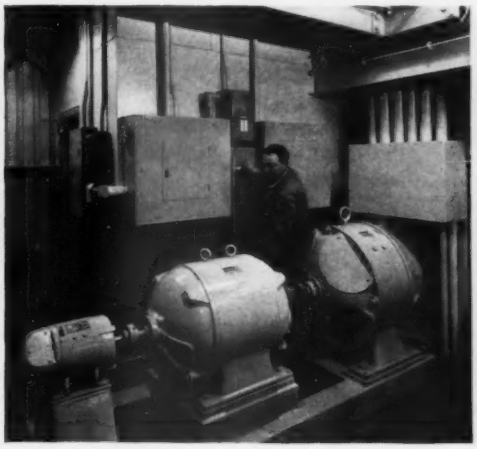
View of main control room in east tower, showing desk from which operator controls all main and auxiliary bridge drives. Special instrumentation, including height and skew indicators, keeps bridge tender informed of all operating conditions. Drive system transfer and power source selection is made from this console. W. C. Carl explains conveniently grouped controls to N. L. Ziegler, Division Engineer (left); J. F. Stevens, Superintendent; and P. K. Partee, General Manager.



Discussing main drive equipment in east tower are M. B. Trimble, Westinghouse Construction Engineer; G. R. Keltie and W. C. Carl. Two type MCPA-614, 135-hp Westinghouse mill motors are shown above—one motor for each of the duplicate drive systems. Systems are arranged so that one motor in each tower can drive span at rated speed. These rugged, heavy-duty, standardized motors assure reliable operation under all conditions. Westinghouse type HI-198 thrustor brakes are used for holding bridge at standstill.

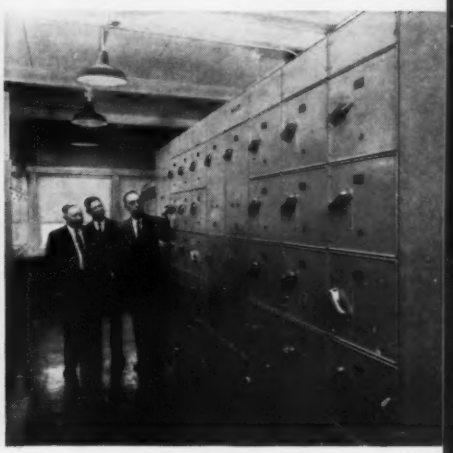
G. R. Keltie, Chief Substation Maintainer, The Staten Island Rapid Transit Railway Company, looks on as W. C. Carl, Westinghouse Construction Engineer, points out details of main d-c control panel. This panel contains type M, 800-amp d-c "loop" contactors, span speed, current limit and skew control Magamps with associated auxiliaries.

Incoming 4160-volt power is reduced to 480 volts by this 500-kva Westinghouse power center. Low-voltage switchgear at rear distributes power to main drive system and bridge electrical auxiliaries. Type DB drawout air circuit breakers provide feeder circuit protection. Discussing installation: John Pucillo, Staten Island Rapid Transit Railway Electrician; Max Pilger, Garfunkel Electric Supply Company; and M. Davis, Westinghouse Sales Supervisor.



John Pucillo is seen operating wall mounted AB-I breaker which controls machinery and room heaters. In foreground, main 125-kw type SK d-c adjustable voltage generator driven by 150-hp type CSP* motor. Generator excitation furnished by Magamp exciter regulator determines operating speed of main drive motors. Small unit at near end is a constant potential generator for drive motor fields and control auxiliaries. The d-c supply for duplicate drive system is furnished by identical equipment.

*Trade-Mark



A Westinghouse control center in the east tower switchboard room is examined by Messrs. Partee, Carl and Ziegler. It contains combination starters for 440-volt auxiliary drives and includes a-c relay panels at each end. Compact control centers are composed of interchangeable, space-saving, easily installed modular units.

J-94150-A3

Interesting view from mezzanine floor, showing one of four span control auxiliary assemblies. A single machinery take-off to the multiple speed gearbox provides correct ratios to operate type A cam limit switches, height, skew and control transmitters. This construction permitted unit preassembly at machinery builder's plant—assuring fast, easy installation. Seen above: W. C. Carl and G. R. Keltie.

Coordinated control system commands world's longest lift span *(cont'd)*

As supplier of the coordinated electrical systems, Westinghouse assumed complete responsibility for their performance. For more information about how this single-source supply can benefit you, contact your nearby Westinghouse construction sales engineer. Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

OWNER: The Staten Island Rapid Transit Railway Company (a wholly owned subsidiary of The Baltimore and Ohio Railroad Company), Staten Island, N. Y.
CONSULTING ENGINEER: Parsons, Brinckerhoff, Quade & Douglas, New York, N. Y.
GENERAL CONTRACTOR: American Bridge Division, United States Steel Corp., Pittsburgh, Pa.
ELECTRICAL CONTRACTORS: Fischbach and Moore, New York, N. Y.
Lightning Electric Service Co., Newark, N. J.
WESTINGHOUSE DISTRIBUTOR: Garfunkel Electrical Supply Co., Jersey City, N. J.

J-94150-A 4

Westinghouse

Freight train moving over the recently completed Arthur Kill Lift Bridge is drawn by a diesel engine of The Staten Island Rapid Transit Railway Company.

1′ x 4′ PLEXIGLAS lenses mounted in continuous line, Ronkonkoma Primary School, Long Island. Architect for both schools shown: Frederick E. Allardt, Jr.

2′ x 2′ PLEXIGLAS lenses mounted in pairs, Southampton High School, Long Island.

PLEXIGLAS

for lighting that stands out and stands up

When lighting equipment includes control lenses molded of PLEXIGLAS® acrylic plastic, the result is illumination of the highest quality—because PLEXIGLAS is:

- molded accurately to the lens pattern, to produce a precisely designed optical element which achieves functional quality illumination. With lenses of the types shown in the installations above, light rays are "bent", providing complete freedom from glare at any normal viewing angle.
- impervious to discoloration from years of exposure to fluorescent light.
- strong and rigid yet light in weight, resulting in safety overhead and ease of maintenance.
- crystal clear, assuring full utilization of light with complete visual comfort.

Full details on PLEXIGLAS as a lighting material are contained in our new technical bulletin, "PLEXIGLAS for Lighting". We will be glad to send you a copy.

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Company of Canada, Ltd., West Hill, Ontario*

Readers' Comment

Against Restrictive Registration

I would like to compliment you on your August editorial re: Restrictive Registration. These are my sentiments 99.44%!

Now if we can go "to bat" against the states who have these obnoxious restrictions!" I've sure done what I could.

Thanks for the article. The profession has needed it for a long time.

Lawrence Supove
Consulting Engineer
Portland, Oregon

Back to Reading

. . . somewhere along the line it was stated in your publication that Gilbert Associates is located in Lancaster, Pennsylvania. I realize that someone may have seen our letterhead and assumed that this was so. Gilbert Associates is located in Reading, Pennsylvania, and if you could possibly include a couple of lines in your next issue of CONSULTING ENGINEER calling attention to the error, I am sure that it would be greatly appreciated.

Thomas F. Godfrey, President
Godfrey Agency, Inc.
Lancaster, Pennsylvania

Re "Unfair Competition"

As a professor of engineering as well as a partner in a consulting engineering firm maintaining off campus facilities, I would like to comment on your editorial, "Unfair Competition From Your Alma Mater," which appeared in the June 1960 CONSULTING ENGINEER.

I agree that it is unethical for any individual, professor or consultant to agree to perform services for which he has no special competence. Further it is improper for any individual or firm to use special advantage such as income from another source to permit fee cutting on consulting work. However, I contend that professors, who take the same responsibilities and meet similar expenses in business as do their competitors, have a clear right to operate such a business.

Frankly I am disturbed by the refusal of publications . . . to look with care into unethical practices of consulting engineers . . . It is a known fact that many structural engineering firms in California will bid on a price basis for work. Many firms will perform architectural work in addition to structural work despite the fact that they have no formal education or competence in architecture. A firm in this area is engaged in design of a large scale flood control project for which no upstream hydrology has ever been performed. Why does it go along with this failure on the part of the public agency for which it is working? Numerous civil engineering firms have designed subdivisions in danger areas such as those which are subject to regular flooding or which lie directly in flight paths adjacent to airports. Is the saving of money on these sites adequate reason to ignore the dangers to future inhabitants? . . . These unethical practices are mentioned not because I am unsympathetic to consultants but because these practices weaken their own position in the battle for work which they can do better than others. In fact, I would like to show how the professor can be wooed away from those practices which compete with the consulting engineer. In accordance with this line of reasoning I offer the following:

¶ Start a campaign to discourage professors from performing work of a routine nature since this type of work is in direct competition with firms which employ former students of the professors and it is to be presumed that there is no shortage of personnel who can perform this type of work.

¶ Simultaneously, make it a practice to retain professors to handle problems requiring advanced training for solution.

¶ Utilize professors, with ability, to set up and plan projects when it is uneconomical to tie up the permanent staff in the planning stage.

¶ Employ this special talent as you would an attorney. Use the retainer approach in contrast to the salary form of payment.

¶ Colleges have traditionally performed research work and they should be encouraged to continue to do so. The loss of work to consultants in this area is small in comparison to the benefits gained by our educational system in training educators and students in research methods.

¶ Pay enough attention to the men in engineering education to assure that only the most competent are so engaged. This means, of course, that the field must be made attractive to those who possess outstanding talent.

I feel that this course of action will go a long way towards the elimination of the problem of the professor-consultant. The association of professor with consultant

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Not just an access door. Half the entire cone comes off.

Speed up inspection . . . slash maintenance and downtime costs.

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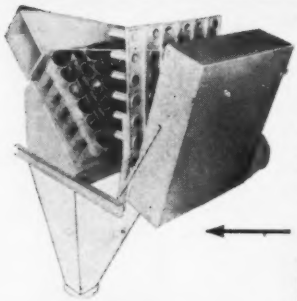

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D-584 with 100% efficiency at 14 microns

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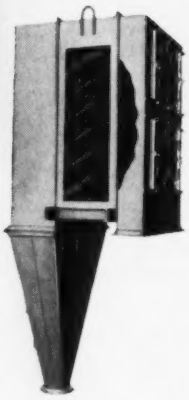
for economical separation of dust from normal or high temperature gas or air.



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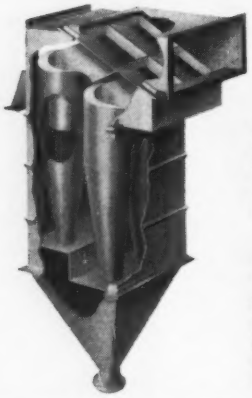
with 99.8% efficiency at 10 microns and smaller for ultra-high efficiency and installations requiring strict sanitation . . . easily cleaned and sanitized thanks to convenient hinged top tube sheet design.



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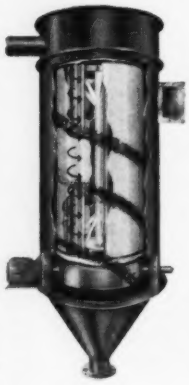
New, Low-Cost DUSTEX "1600" brings a higher Dustex Performance to collectors in Lower Price Range.

DUSTEX ROTO-JET CLOTH COLLECTOR →

Dustex Engineering eliminates usual cloth problems through a completely new design . . . drastically lowers operating and maintenance costs.



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For all Hopper and Bin Discharges

(Under Negative Pressure)

DUSTEX VACUUM VALVE

No motive power required.
No mechanical parts.
Maintenance free.
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ON THE JOB DETERMINATION TEST YOUR BEST GUARANTEE

The Dustex Single Tube Determination Test, performed under actual operating conditions, provides exact data with which to specify equipment. No cost or obligation.

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will result in improved educational and consulting practice.

George M. Sicular
Lorell & Sicular
San Jose, California

High Cost Engineering

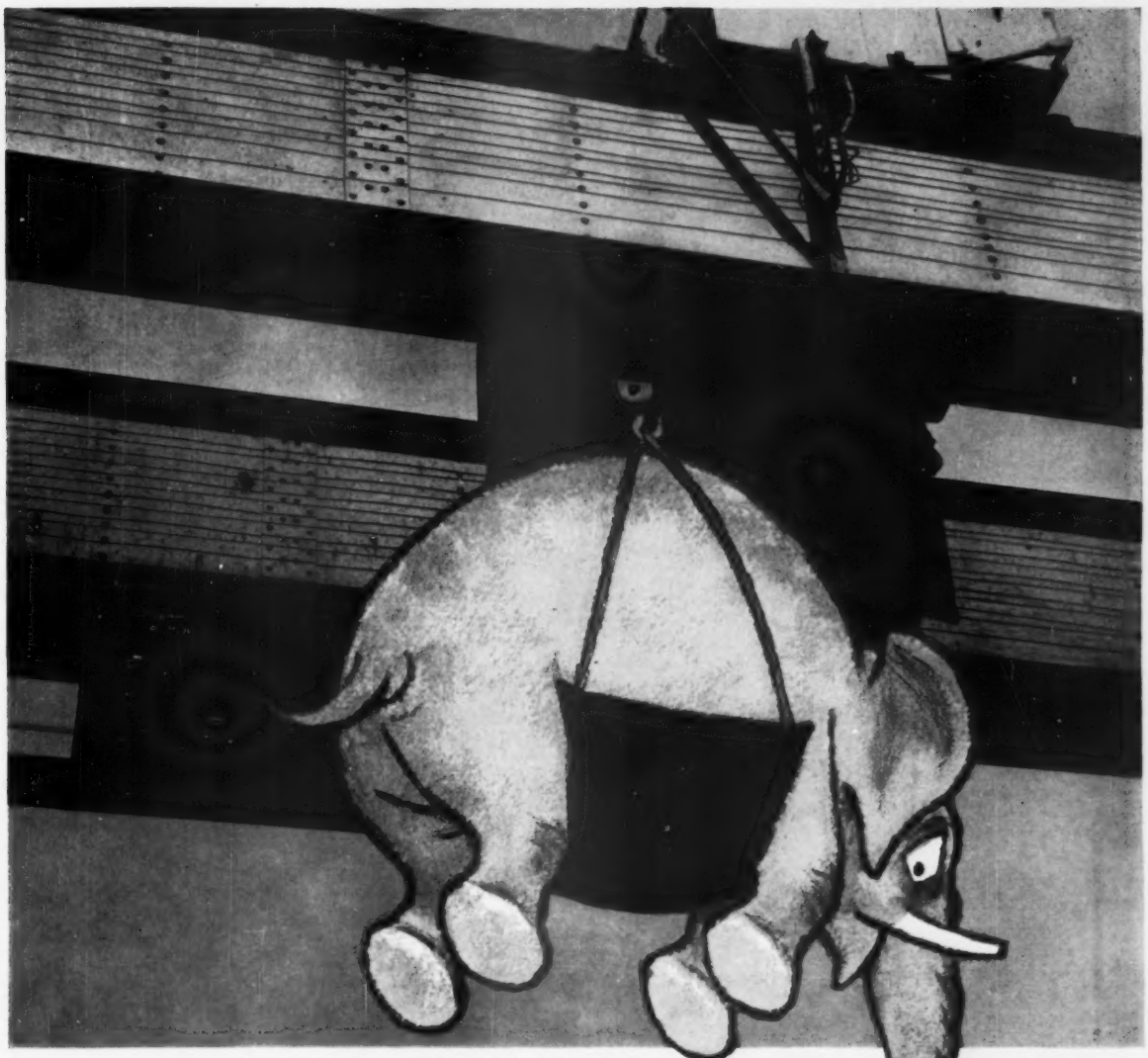
In your August issue, in the article, "What Did Hoover Really Report," you indicate surprise, and even a little skepticism, at the percentage costs for engineering indicated for some governmental agencies. I fear you are just ignorant of the operations of typical governmental engineering bodies.

The Bureau of Reclamation is noted for its high engineering costs. I have before me their report on the construction of Platoro Dam in Colorado, constructed in 1949-1951. The report is dated 1954. It shows contract payments of $2,528,813.04, government furnished materials amounting to $37,824.91, and general expense of $538,000. General expense is indicated to be investigations and preconstruction surveys, preparation of designs and specifications, supervision of construction, and administrative and general expenses. So, according to this, general expense, or engineering costs, amounted to 20.9%.

However, included in contract payments were $34,379.37 for the government camp and facilities, which costs would be really be part of the engineering costs. Shifting this amount from one group to the other, we arrive at a percentage of about 22.5.

I also have here the Bureau of Reclamation report on the Superior-Courtland Diversion Dam in Nebraska, constructed in 1949-1950, with the report dated 1953. In this report are shown direct costs of $1,403,262.68 and indirect costs of $235,826.37. Indirect costs are described as investigation, surveys, design, construction supervision, and administrative expense. Indirect costs amounted to 16.8% of direct costs.

However, in talking of engineering fees one usually is talking of



TAKE THE WHITE ELEPHANT OUT OF MATERIALS HANDLING

Don't let the weighty "White Elephant" of obsolete or inadequate Overhead Materials Handling equipment add a burden to plant efficiency and economy. When you build—or rebuild—check Whiting.

Whiting Cranes are made-to-measure to match the job at hand. Fully controllable, quiet running; various models lift loads from 5 to 450 tons without complaint, speed up production, reduce handling costs. You see them everywhere. On standby. In day-to-day plant operation. Always dependable. Always ready.

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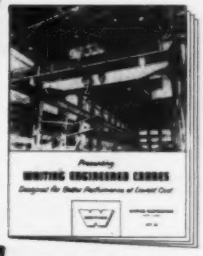
Whiting Corporation, 15620 Lathrop Avenue, Harvey, Illinois. In Canada: Whiting Corporation (Canada) Ltd., 350 Alexander Street, Welland, Ontario, Canada.



WRITE FOR: "Presenting Whiting Engineered Cranes"; Bulletin 80, for basic facts.

See Our Catalog in SWEET'S

87 OF AMERICA'S "FIRST HUNDRED" CORPORATIONS ARE WHITING CUSTOMERS

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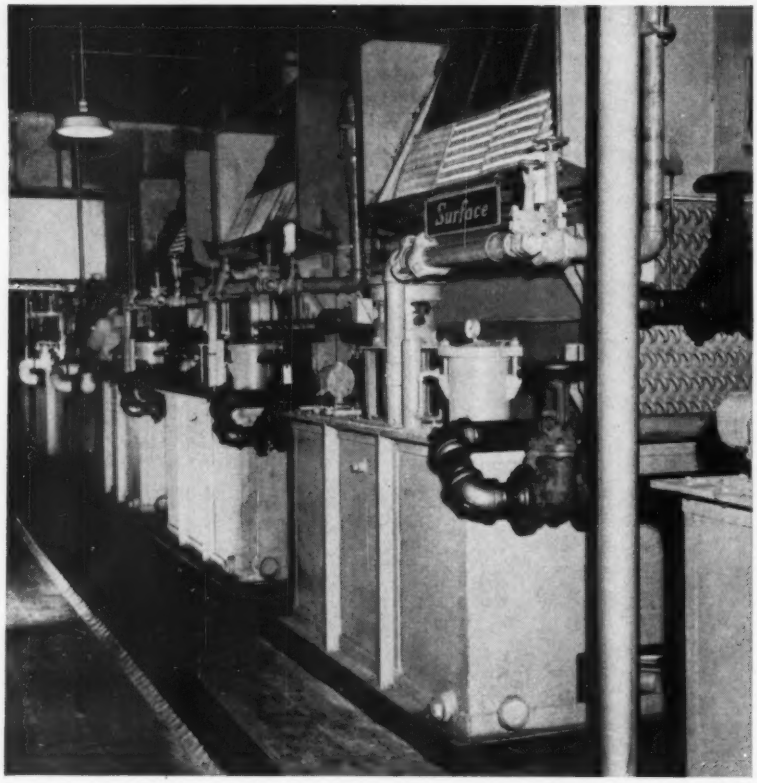

120 GRAINS CUT TO 45

IN 200,000 cfm OF AIR

WITH 85° TOWER WATER

Without Kathabar, this job would have taken 1800 tons of refrigeration, at about 35F and reheating air from about 45F to 98F! With Kathabar the job took 63 hp instead of 2000. Ask the men who have seen Kathabar Type C units serve for years with practically no maintenance. Write for specific information.

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Send facts on Kathabar systems for the following application:

name and title.....

company.....

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city.....*zone*.....*state*.....

percentages of construction costs, not including land costs. If the cost of land rights of $110,600.54 is deducted from the direct costs, then the indirect costs amount to 18.25% of construction costs.

The report indicates that government crews were working on various projects in the same vicinity, but that the average number of men on this job was 11. I know of present construction jobs running up to $6 million each, on which the engineers have no more than four men or so for supervision. So you can see why the governmental jobs run high.

(Name withheld on request)

Conditions of Contract

I have read Mr. Nord's comments with great interest and consider them a very fair comparison of the FIDIC and CEC Conditions. They will be a useful commentary to put alongside those FIDIC has received from Member-Associations in making revisions of the International Conditions, which come up for consideration at the next meeting of the Executive Committee in September.

I think the general feeling of the General Assembly, when it met in Stockholm in June, was that it was still too early to start the revision of an international document after a period of three years, during which only limited experience with its use has been obtained.

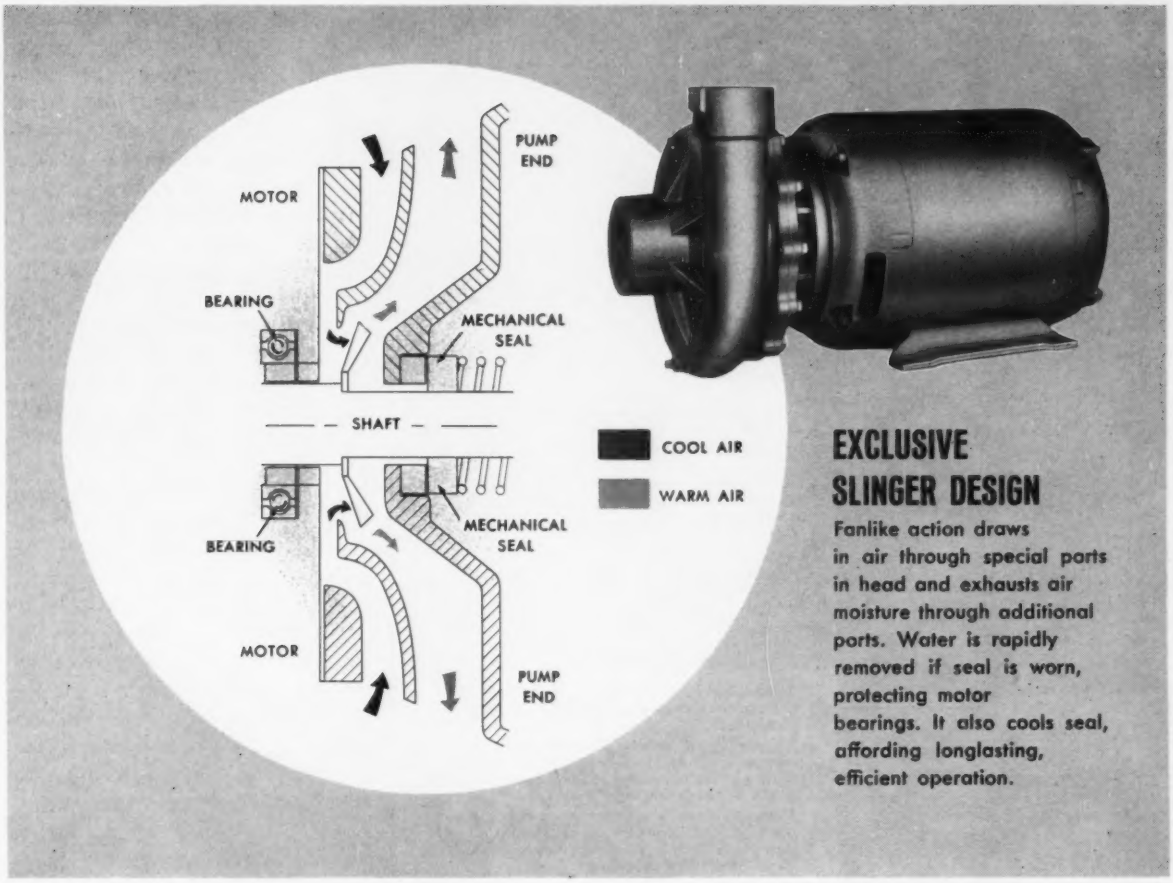
Julian S. Tritton, President
Federation Internationale
des Ingenieurs-Conseils
London, England

The Engineers Index

The January 1958 issue of CONSULTING ENGINEER published a staff report, "Good Catalogs — How Consultants Use Them." Reference was made to a committee (Consulting Engineers Council and The Producers' Council) working on the development of an engineers index.

Has the engineers index been developed? If so, who shall we

NEW DUNHAM-BUSH A9 CENTRIFUGAL PUMPS PROVIDE 2-WAY PROTECTION AT DANGER ZONE


PUMP END
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EXCLUSIVE SLINGER DESIGN
Fanlike action draws in air through special ports in head and exhausts air moisture through additional ports. Water is rapidly removed if seal is worn, protecting motor bearings. It also cools seal, affording longlasting, efficient operation.

Now Dunham-Bush offers a complete line of close coupled centrifugal A5 and A9 pumps for far reaching applications.

The new heavy duty, quality A9 pump expands the Dunham-Bush centrifugal pump line to 51 size standard models . . . 1750 or 3450 RPM, high capacity and head . . . plus non-standard pumps with special impellers.

Dunham-Bush A9 pumps contain built-in safety factors comparable to that of the pipe and fittings; components designed for heavy duty use; seals for temperatures up to 250°; case held to head with 12 bolts; discharge connection that can be rotated to 12 different positions.

Get full details of the sensational new Dunham-Bush A9 and A5 pumps. Request bulletins 1440A and 1442.

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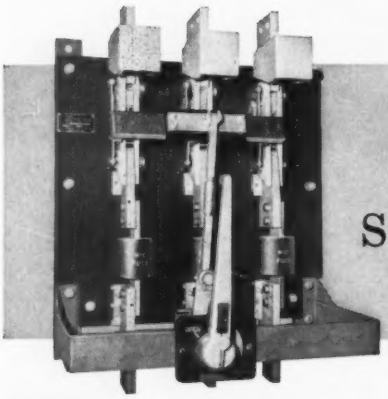
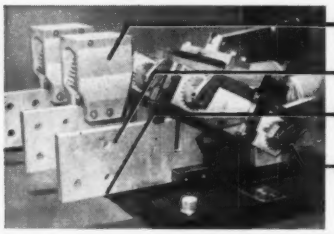


A New Load Break Service Entrance Switch

BOLT-LOC* by BARKELEW

FOR 1200 • 1600 • 2000 AMPERES • 240 • 480 • 600 VOLTS

Designed primarily for use with high interrupting capacity fuses for service entrance applications, and with or without fuses, as isolating switches, feeder disconnect or protector switches, for controlling electrochemical processes or any other use where cool operation, rugged construction, safety and complete reliability are required. Thoroughly tested for interrupting, short circuit and load carrying capacity.

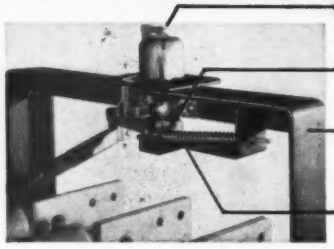


Molded arc suppressing material houses double slot multiple steel plate arc quenchers.

Vertical terminal contacts for easy bus and cable connections.

Using adapters, bus bars can be mounted parallel to base.

Positively locked forged nut for adjusting contact pressure, pre-set and locked at factory. Stainless steel spring holds initial contact pressure.



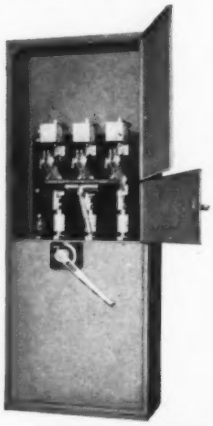
Handle contains latch for holding switch open or closed and slot for four padlocks.

Large bronze sleeve bearing supports operating shaft. Close tolerances throughout the switch mechanism give positive operation and long life.

Formed frame supports operating mechanism. No additional supports needed. Switch is adjusted before shipment, ready for mounting.

Quick break mechanism opens switch rapidly, drawing arc thru quenchers where it is quickly extinguished, usually in less than 1½ cycles.

Available standard enclosures 32″ wide by 14″ deep by 76½″ high. The fuse door and the upper switch access door are interlocked with the switch handle to prevent opening the doors with the switch closed or closing the switch with the doors open. The handle is arranged for using four padlocks in open and closed positions.



FOR COMPLETE DETAILS WRITE FOR

BULLETIN NO. 101

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THE BARKELEW ELECTRIC MANUFACTURING CO.

MIDDLETOWN, OHIO

ELECTRICAL SWITCHING EQUIPMENT SINCE 1904

contact for information? We are attempting to organize our library and would appreciate any information available.

Glenn Noble
Johnson & Anderson, Inc.
Pontiac, Michigan

• *The Consulting Engineers Council-Producers' Council Joint Committee is still at work on the Engineers Index. Chairman LaTour says that considerable progress has been made, but the end is not yet in sight.*

Likes Sewage Article

. . . sewage plant manufacturers' representatives in St. Louis are clamouring for copies of CONSULTING ENGINEER for September 1960. I have already given my office copy away.

I am writing to ask if I could have three additional copies of the September issue, one to replace my copy and the other two to pass along to friends.

I have not had the opportunity to more than scan your coverage of "Sewage Treatment," but I see enough to convince me that you are going to receive nation-wide commendation for some time to come on this effort.

Joe Williamson, Jr.
Williamson & Associates
St. Louis, Missouri

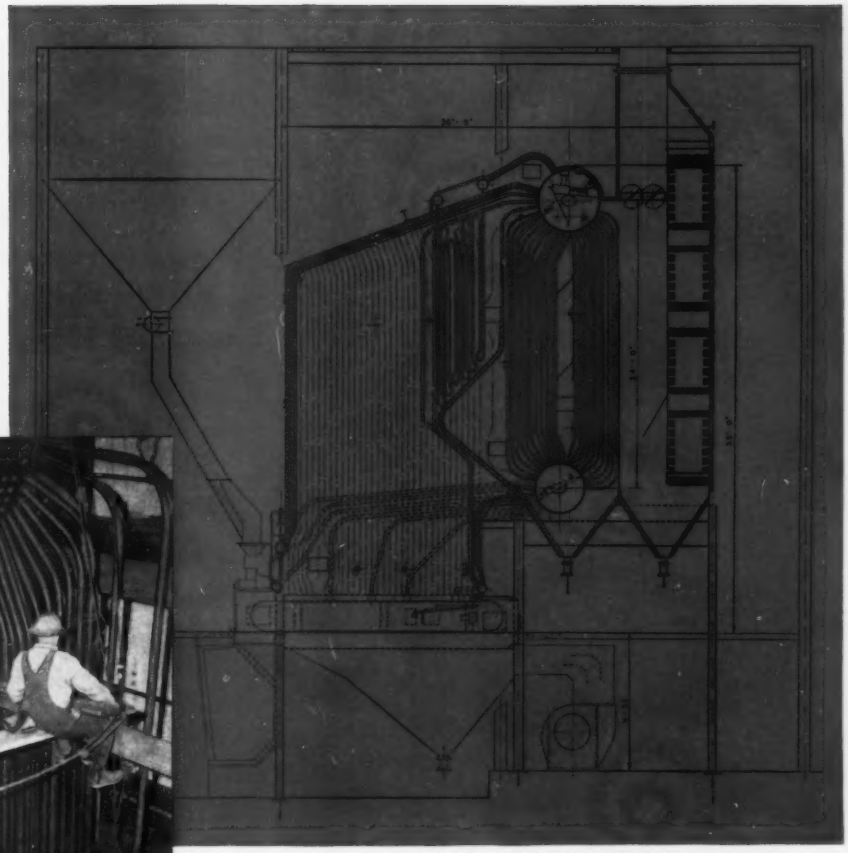
Reed's Woodcuts Admired

If your supply has not been exhausted, I would appreciate receiving a copy of the special print of Philip Reed's wood-engraving which you offered for distribution in the September issue of CONSULTING ENGINEER.

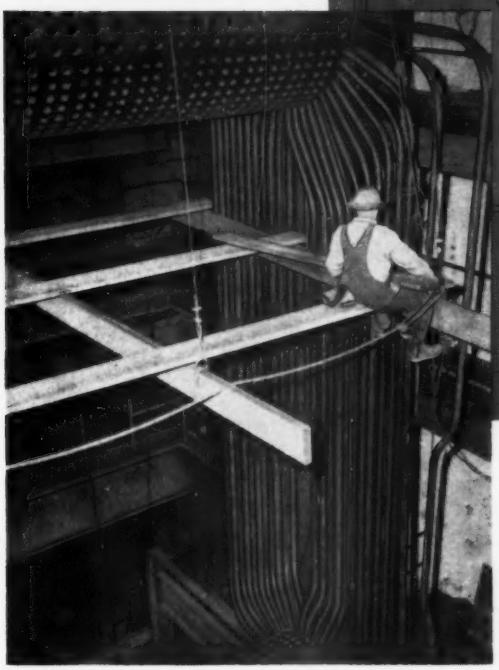
I would also like to take this opportunity to let you know that I think your magazine is, by far, the best of its kind anywhere, and that I certainly appreciate being on your mailing list.

J. R. Dorsey
Specifications Engineer
Rummel, Klepper & Kahl
Baltimore, Maryland

Union Starch Installs a Modern Coal Fired Steam Generator



Longitudinal section through unit.



Tubes being installed in steam and water drums.

PROJECT BY
ROGERS SCHMIDT
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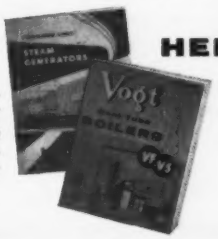
ST. LOUIS, MO.

This 125,000 pounds per hour capacity Vogt Steam Generator, especially designed to burn bituminous coal, serves the Granite City, Illinois plant of the Union Starch and Refining Company. The unit operates at 475 lbs. pressure and delivers steam at 750°F. total temperature. It has water cooled front, sides and roof of furnace and employs a spreader type coal stoker.

Vogt offers a complete line of custom built and package type steam generators for power, processing and heating. Bulletins are available upon request.

Vogt

For Custom Installation Bulletin VF-VS-2 • Package Unit Bulletin PSG-3, address Dept. 24A-BCE



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SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., Los Angeles, St. Louis, Charleston, W. Va.

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STEAM GENERATORS

NOW-

Reason 1....
Reason 2...

You can gain important *new advantages* when you use Armco FLEX-BEAM Guardrail. Highway-tested Armco FLEX-BEAM is now available with a protective zinc coating. It is supplied in double lengths—25-foot long sections—that speed installation. These double lengths eliminate five out of every ten splices. And the number of sections that must be hauled to the job site and handled is reduced by half. Of course, the single length sections of FLEX-BEAM continue to be available.

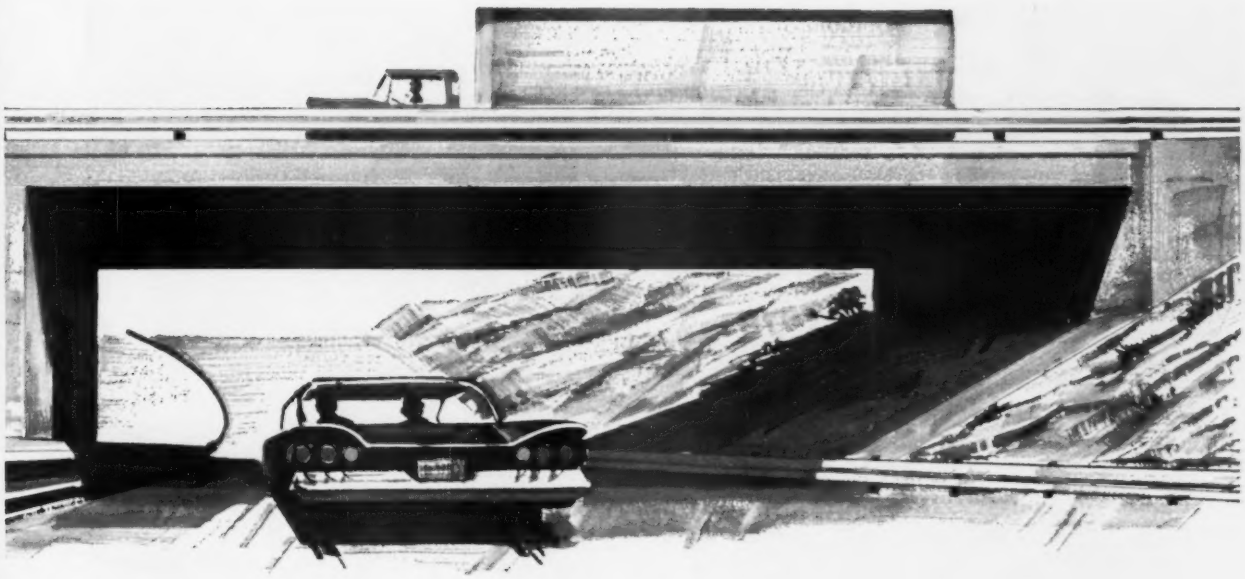
With galvanized FLEX-BEAM, the zinc coating provides surface protection for the metal—eliminating the need for painting. Or, if painting is desired for utmost visibility, it can be limited to the *face* of the rail. This is especially important for installations against walls or machinery, highway median strips, double-faced parking lot installations and similar uses where the back of the rail is inaccessible for maintenance painting. Total result is simpler, lower cost installation and maintenance.

Condensed FLEX-BEAM Specifications

Gage:	10 and 12
Length:	12′-6″ and 25′-0″ (25′ sections supplied in 12-gage, galvanized steel only).
Coating:	Shop applied, rust-inhibiting prime paint or Galvanized to meet ASTM A-93 (Class 2.5 oz. coating).
Shop-Curved Sections:	Fit any radius from 5′ to 150′.

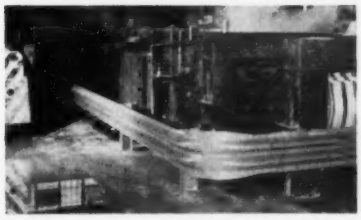
Send for free catalog

Send the coupon for the latest edition of the 12-page Armco FLEX-BEAM Guardrail catalog. Armco Drainage & Metal Products, Inc., 5880 Curtis Street, Middletown, Ohio.

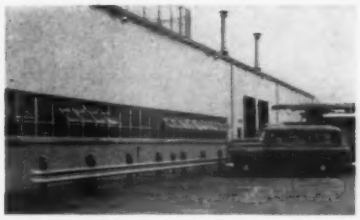


--you have Two More Reasons for selecting Armco Guardrail

DOUBLE LENGTHS to speed installation and cut costs
GALVANIZED to simplify painting and reduce maintenance



FLEX-BEAM protects valuable machinery in plant.



FLEX-BEAM adds parking lot safety.

FLEX-BEAM installation on Chicago's Calumet Skyway.

Armco Drainage & Metal Products, Inc.
Department C
5880 Curtis Street, Middletown, Ohio

Send my copy of the Armco FLEX-BEAM Guardrail Catalog

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Organization_____

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EVAPORATOR FEED TANK OVERFLOW
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Now from Edwards long experience in annunciator systems, comes a completely new line of lamp annunciators incorporating outstanding operational features . . . developed in cooperation with consulting engineers, leading power stations, chemical process and industrial plants. Design and operational flexibility is keyed to present and future demands of automatic process control and all types of automated systems. Edwards technical specialists in 58 cities across the country can show you how Edwards lamp annunciator systems can provide the most reliable flexible operation for every type of indication. Write for your copy of a new descriptive Bulletin A-200. Edwards Company, Inc., Norwalk, Conn.

NO OTHER ANNUNCIATOR OFFERS YOU ALL THESE FEATURES:

Operation: 1. Operational sequences may be changed without altering terminals, connectors or jumpers, even while power is on. 2. Operation from normally-open or normally-closed circuit contacts may be easily changed after installation by merely plugging in the designated relay unit. 3. No power drain—no "dropping resistors" to burn out or cause internal heating. 4. Wide selection of operational sequences. 5. Simple specific purpose "plug-in" circuits. 6. Indicating circuit provides extra contacts and independent terminals for data logging or other control functions. 7. Test for all indicating lamps on annunciator as standard equipment. **Design:** 1. Complete modular construction for flexibility of application. 2. One-piece molded lamp compartment and indicating plates snap into position. 3. Long-life under-voltage, double contact bayonet lamps will not loosen. 4. Relamping from front without opening door. 5. Lamps in multiple, no signal loss in burnout. 6. Dust resistant, continuous gasket front and back. 7. No exposed live parts. 8. Circuits plug in—vibration-proof lock. 9. No mounting holes required for panel mounting types. 10. Long-life relays—high temperature insulation, diffused gold contacts of higher rating, nylon coil, sealed windings. 11. Hermetically-sealed relays available when specified. 12. Heavy-duty barrier-type terminals accommodates through No. 10 AWG wire.

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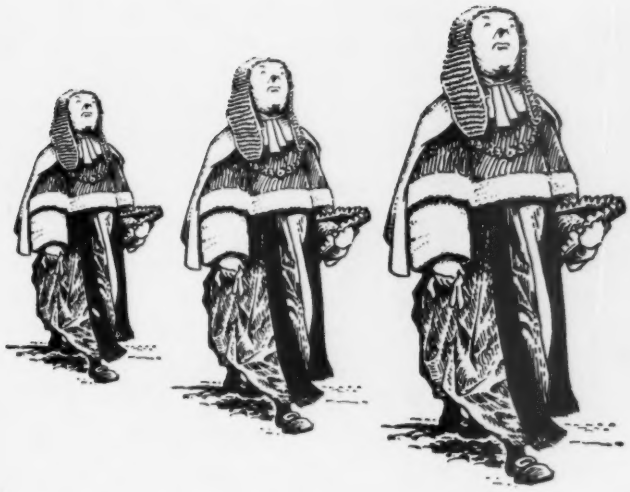


The Legal Aspect

MELVIN NORD, P.E.
Consultant in Legal and Technical Problems
Patent Attorney

The Conflicts of Corporate Practice

THE COMMITTEE on Model Law Revision of the National Council of State Boards of Engineering Examiners met in Columbia, South Carolina, on March 11, 1960, to prepare a draft of proposed revisions of the Model Law for registration of professional engineers. This draft was approved at the recent Portland meeting.

One of the principal problems was with the question of whether or not the corporate practice of engineering should be prohibited or regulated. Many groups felt that an individual should be permitted to use his own discretion as to how he conducts his business. Others insisted, however, that an engineer should not be allowed to practice through the medium of a corporation at all, or not unless the majority of the members of the firm are legally registered as professional engineers.

Section 22 (d) of the draft reads as follows: "This Act shall not be construed to prevent or to affect: The practice or offer to practice of engineering, as defined by this Act, by individual registered professional engineers, through a partnership, joint stock company, or corporation, as agents, employees, officers or partners, provided they shall be individually liable for their professional acts, and further provided that all personnel, of such partnership, joint stock company or corporation, who act in its behalf as engineers are registered under this Act or are persons practicing lawfully or are exempt under Paragraph (b) of this Section; and provided further that the partnership, joint stock company or corporation providing engineering services shall be jointly and severally liable with such individual registered professional engineers, and further provided that all final plans, designs, drawings, specifications and reports, involving engineering judgment and discretion, when issued, shall be dated and bear the seals and signatures of the engineers who prepared them."

Since this paragraph is the subject of continued study, and is of considerable interest and importance to engineers, let us consider the merits of the general controversy, and the effectiveness of this proposed section in solving the problem.

Why Not Corporate Practice?

There are two reasons why the corporate practice of engineering may be regarded as objectionable. First, it insulates the engineer from personal liability for his professional conduct, and second, it prevents him from having a personal fiduciary relationship or position of trust with the client.

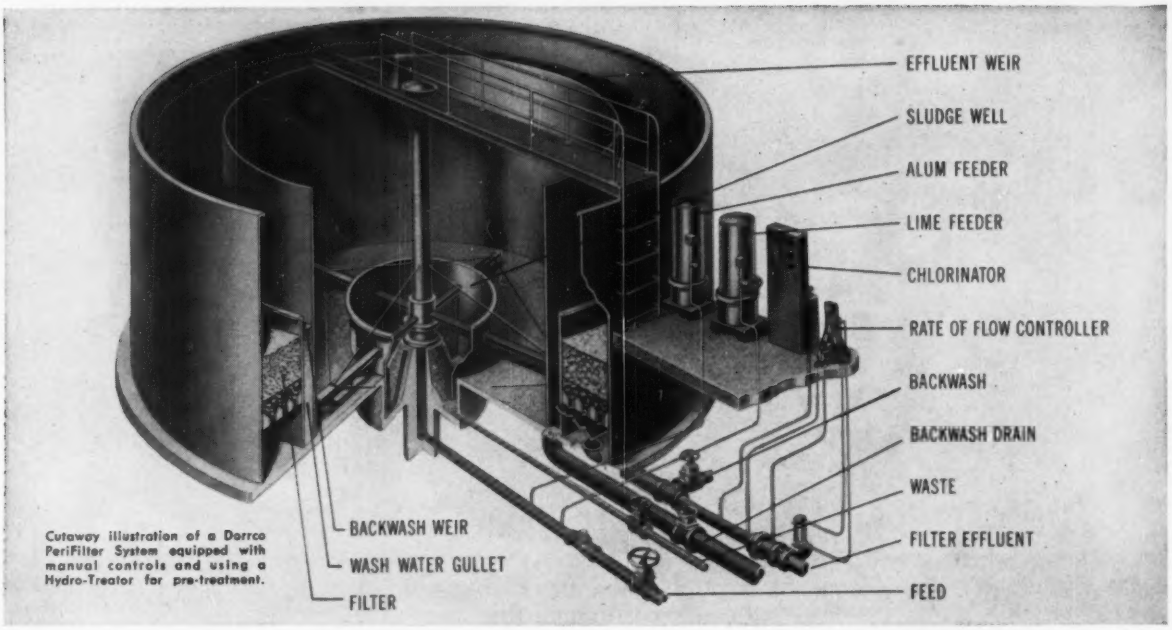
It will be noted that these reasons have no special or particular relevance to the practice of engineering as such. Instead, they have to do with the nature of a "professional" relationship, as it is generally understood in all professions. Thus, it is characteristic of professions, in general, that corporate practice is not permitted.

It is recognized that there may be some reason for engineers to deviate from the standards of other professions. There may, in fact, be a significant difference in this particular respect, that engineering firms may in certain cases require the raising of capital, whereas this is not the case in other professions. Nevertheless, before abandoning such a cardinal rule of professionalism, we ought at least to consider carefully what the objections are to abandoning the rule, and whether abandonment is needed to solve the problem.

Personal Liability

The greatest difference between the corporate and partnership type of firm is that there is no personal liability (beyond the investment) of members of a corporation, but unlimited personal liability of each partner in a firm.

It may be argued that a professional man should not be allowed to shield himself behind the



Cutaway illustration of a Dorrco PeriFilter System equipped with manual controls and using a Hydro-Treator for pre-treatment.

NEW DEVELOPMENT IN "UNITIZED" WATER TREATMENT

Dorrco PeriFilter Systems now available with manual, semi-automatic and full-automatic controls . . . costs are cut still further . . . design flexibility greatly increased . . .

Experience gained since 1954 has now been translated into major improvements in the Dorrco PeriFilter System. The basic design, field-proven on a wide range of treatment conditions, permits installation of pre-treatment unit and filter in a single tank. With this "unitized" approach, additional units can be added as demand increases. Construction costs are cut up to 40% compared with conventional pre-treatment and separate filter plants.

Now, with the availability of manual, semi-automatic, or full-automatic controls, a standard PeriFilter System can be selected to provide maximum economy consistent with good engineering practice. On a "unitized" basis, manually operated units are available with capacities up to 2 MGD and semi-automatic units up to 6 MGD.

A Dorrco Hydro-Treator or Dorrco Clariflocculator can be incorporated in the PeriFilter so that either high-rate or conventional pre-treatment can be utilized. Using one or another of these combinations, Dorrco PeriFilters are now in successful operation removing hardness, turbidity, color and/or iron and manganese.

If you'd like more information on the Dorrco PeriFilter System, just drop a line to Dorr-Oliver Incorporated, Stamford, Conn.

Hydro-Treator, PeriFilter, Clariflocculator T.M. Reg. U.S. Pat. Off.

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corporate veil in order to escape personal liability for his own professional lapses or misconduct. He holds himself to be competent in his profession, and his client is not qualified to judge this for himself.

The proposed revision of the Model Registration Law attempts to overcome this objection, in that corporate practice is not affected, "provided they shall be individually liable for their professional acts . . ." This provision, however, fails to solve the problem. It merely specifies that this is permissible, but it does not prohibit the contrary. Furthermore, this section in no way purports in itself to make the person in a corporation doing the work personally liable. It merely hints in a backhand sort of way that if it should somehow come about, it would be nice. However, in fact, it is not at all likely to come about, since it is certainly not common for an officer or agent of a corporation to be personally liable for corporate contracts. This concept not only does not fit with the nature of a corporation — it is basically antagonistic to it. Thus, the proposed law would in fact not prohibit corporate practice of any type whatever, and would certainly not make the engineer personally liable.

On the other hand, it may be argued that if the engineer is actually negligent, he will be personally liable under ordinary tort principles of law, regardless of whether he is a member of a corporation, partnership, or other form of business organization. This is perfectly true, but it fails to touch the case of contract liability. If the engineering firm contracts to do something and an engineer of the firm does it negligently, he is personally liable, as well as his firm; but if it is not done at all, the liability is purely contractual, and falls only on the contracting party, e.g., on the corporation. This is actually the area of personal liability which is missing in corporate practice. Whether or not this is an area of practical importance in engineering practice is difficult to say. It does not appear to be very great, but it can hardly be classed as negligible.

Closely related to the above problem is the question of whether one member of a firm is responsible for the acts of another member of the firm. In the case of a partnership, every partner is fully liable for the acts of all other partners and employees within the scope of the partnership business. In the case of a corporation, however, this is not so. It is only the corporation which is liable, and this means each persons' investment is all that is at stake insofar as he is concerned. The provision in the proposed Model Law that the "corporation providing engineering services shall be jointly and severally liable with such . . . engineers . . ." fails to touch this problem at all.

Thus, in a partnership, in essence every partner guarantees the competence and performance of every other partner and employee. No member of the firm can escape personal liability by saying that someone else in the firm was incompetent or careless. This is very important to persons dealing with a firm, since they cannot know who in the firm will do what part of the work. They can rely fully on the person or persons with whom they personally deal, regardless of who turns out eventually to be at fault. But this simply cannot be so in the case of a corporation, and the proposed law in no way purports to accomplish this.

The Effect of Liability Insurance

While personal liability may be lacking to a considerable extent in the case of corporate practice, this may not be as important today as it once was. Every professional man, it now seems, is trying to find a way out of his personal liability by means of professional liability insurance. No one has objected to this, so far as I am aware,

CONSIDER YOUR FUTURE IN

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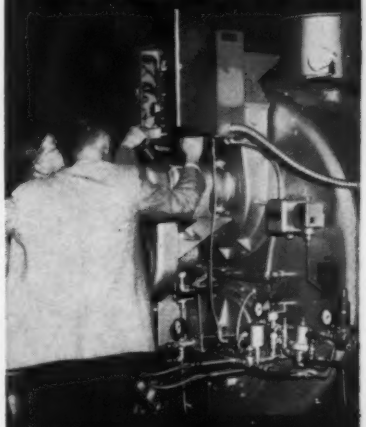

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Keeping up-to-date with the latest developments provides you with the information you need to know to grow. That's why the Power Show is so vitally important to you. There you will see up-to-the-minute developments in hundreds of power specialties widely used in the power industry.

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AUSPICES ASME

NEW YORK COLISEUM

NOV. 28—DEC. 2, 1960

MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY
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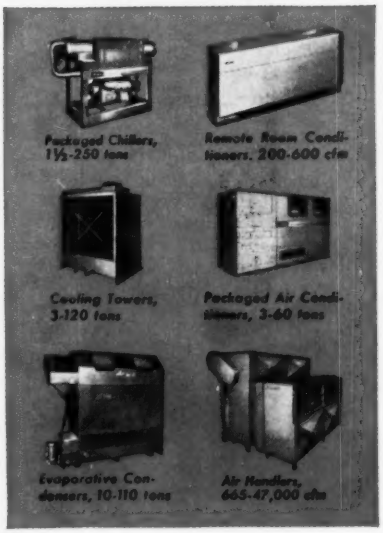
Architects: A. L. & S. G. Brooks, Atlantic City

Air conditioning in the summer... ice skating in the winter by Acme

And the beauty of it is that this summer-winter combination does *not* require two separate cooling systems with complicated and costly interconnections, change-overs and controls. Here at the Colony Motel, Atlantic City, the 160-ton Acme installation includes two 60-ton packaged chillers, a 120-ton cooling tower, plus a specially designed "combination" 40-ton chiller with tower. In the summer this entire system is devoted to air conditioning the Colony's 270 units. Come winter, the 40-ton system is simply switched from chilling water for air conditioning to chilling brine for the ice skating rink.

That's the Acme practical approach at work. And how well it works is best testified to by those most directly involved . . . J. P. Hartmann, consulting engineer, Havertown, Pa., who specified the system . . . Benjamin E. Labov & Sons, contractor, Atlantic City, who installed the system . . . Tisch Realty Co., owners of the Colony . . . Acme boosters all. Ask them. Or, if you're more specifically interested in details on this unique Acme dual-purpose package, ask your nearby Acme representative to fill you in. He has the complete story and he'll be happy to work with you. Call him, right now, while you're thinking about it.


Packaged Chillers, 1½-250 tons
Remote Room Condensers, 200-600 cfm
Cooling Towers, 3-120 tons
Packaged Air Conditioners, 3-60 tons
Evaporative Condensers, 10-110 tons
Air Handlers, 665-47,000 cfm

Acme INDUSTRIES, INC.
JACKSON, MICHIGAN

MANUFACTURERS OF QUALITY AIR CONDITIONING AND REFRIGERATION EQUIPMENT SINCE 1919

and if that is the case, it certainly makes a big dent in the argument that corporate engineering practice is unsatisfactory because of lack of personal liability. Thus, if a corporation carries sufficient liability insurance, the client is fully protected economically. And if the members of a partnership carry liability insurance, they are nearly as free of personal liability as if they were members of a corporation. Therefore, why all the hullaballo?

If we really believe that personal liability is vital, we should object not merely to corporate practice, but also to professional liability insurance. If we do not object to such insurance, we should forget about personal liability as the basis for prohibiting corporate practice.

Fiduciary Relationship

Actually, personal liability is not important so much for the economic security of the client, as to assure that all members of the firm are doing more than a mere "arm's length job." They are supposed to be professionals, and hence are supposed to behave as fiduciaries or persons in positions of trust, rather than as caveat emptor salesmen.

This problem of the fiduciary relationship between the client and the persons who do the work is also of independent significance in determining whether or not corporate engineering practice should be allowed. In a partnership, the partner doing the work is not just personally liable in an economic sense, but also has a personal fiduciary duty to the client. This is not so in the case of a corporation. It is only the corporation which owes a fiduciary duty to the client. While it may be argued that a fictional legal entity cannot have the ethical standards required of a fiduciary, this is no longer so as a legal proposition. Many fiduciaries are, in fact, corporations.

Thus, the corporation owes the fiduciary duty to the client, and the officer or employee owes a fiduciary duty to the corporation. It therefore may appear as though the corporate form of doing business does not "insulate" the person doing the work from his fiduciary duty to the client. However, to a considerable extent, it really does insulate him and weaken his fiduciary duty to the client. For one thing, his job or his position in the firm is likely to be his real interest, and he may not even know or deal with the client. He may, in fact, find that his duty to the corporation conflicts with his (otherwise) duty to the client. In this instance he has a legal duty to benefit his firm rather than the client. This, of course, is not good, but it is inherent in corporate practice, where no one person must accept responsibility for anything. It is certainly not professional.

Of course, this is not entirely limited to corporate practice. It is true to some extent of any employee in any type of firm. But, at least in a partnership, the partners are in no way shielded from their fiduciary duty to the client.

Thus, the real objection to corporate professional practice is that it impairs or destroys the fiduciary relationship between the professional man and his client. Lack of personal liability is not the real problem; it is merely an outward indication of the basic difficulty.

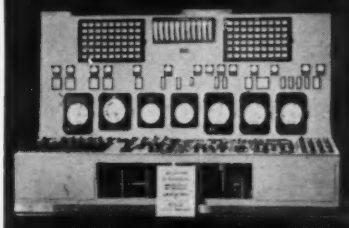
If engineers really wish to be professional, they must accept full personal responsibility to the client, and not to someone else. This cannot be done under the corporate form of practice.

The Solution

It is entirely possible to maintain conventional professional requirements as to personal responsibility, while still permitting the raising of capital. This can be done through the use of the "limited partnership" (or "partnership association" as it is called in some states). This will be discussed in the next article in this series. ▲▲

WHAT COMES UNDER

ENERGY CONTROL?



On paper it's just a phrase, but at work with you and your company it's important. Everything from fuel savings to calculating nuclear fuel costs comes under the heading of "energy control"—a subject of profit to you and your company.

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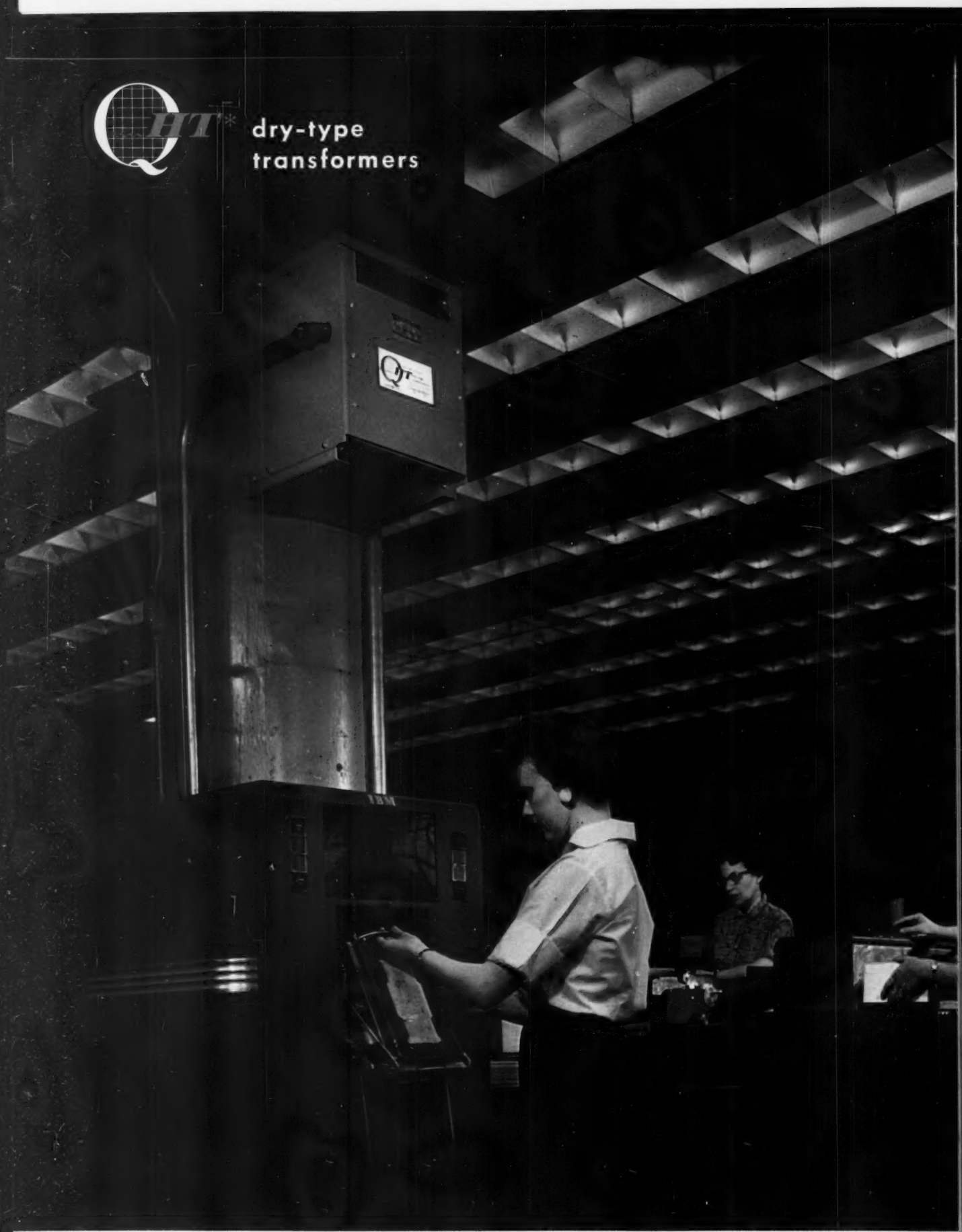

Wall-mounting of this compact QHT transformer provides bonus floor space for equipment and personnel.

Lighter, smaller General Electric QHT transformers give bonus floor space

The new General Electric QHT dry-type transformers save you production space because they offer savings up to 50 percent in weight and 67 percent in size compared with competitive dry-types. QHT units up to 75 kva have built-in provisions for wall mounting, and larger units can be set in out-of-the-way places near the load, saving the cost of long, low-voltage feeders.

A new insulation system permits use of smaller coils to reduce size and weight of QHT transformers. Inorganic silicone impregnated insulation is highly resistant to water, dust, and corrosive atmospheres. Also, aluminum conductors and cold-rolled, grain-oriented silicone steel combine to give you a smaller, lighter, quiet transformer designed for years of dependable service.

QHT dry-type transformers are easy to install. Units have conveniently placed, dual-sized knock-outs, large terminal compartments and wiring spaces. All wiring can be done from the front.

QHT transformers are quiet—at least 15 decibels quieter than older designs. All have sound levels equal to or less than NEMA standards.

You can get 24-hour delivery on most models from your nearby General Electric distributor. Call him for complete information, or write for GEA-6907A "QHT Specifier's and Buyer's Guide" to Section 411-16, General Electric Co., Schenectady 5, N. Y.

* Registered trademark of General Electric Company for quiet, high-temperature dry-type transformers.

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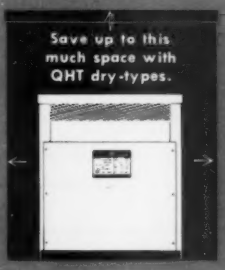
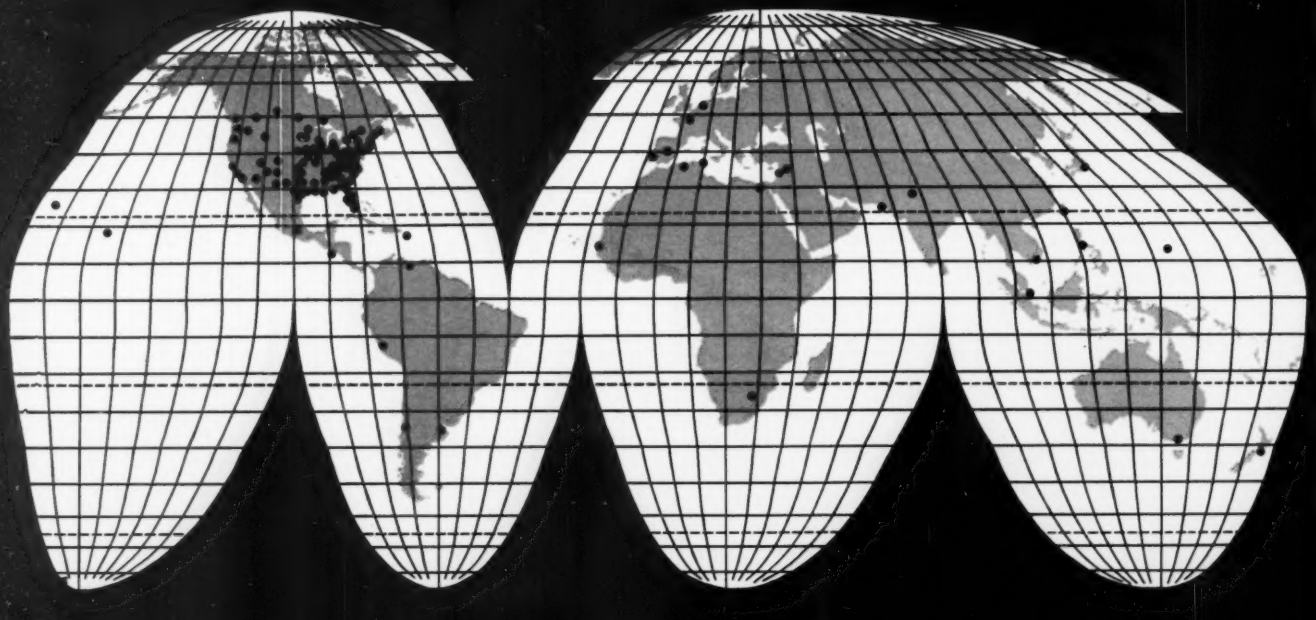


	NEW QHT	TRANS. "A"†	TRANS. "B"†	TRANS. "C"†
45 KVA				
Height (in.)	26 1/4	41 1/4	30	32
Width (in.)	24	28 5/8	31	22
Depth (in.)	19	26	19	28 1/2
Weight (lbs)	430	780	790	500
Volume (cu. in.)	11,970	30,695	17,670	20,064
225 KVA				
Height (in.)	44 1/4	60	50	66 3/4
Width (in.)	41	54	56	55
Depth (in.)	24 3/4	30	28	37
Weight (lbs)	1500	2300	3000	2500
Volume (cu. in.)	44,902	97,200	78,400	135,836

† Transformers "A," "B," and "C" represent products of well-known transformer manufacturers. Data was taken from current published information.



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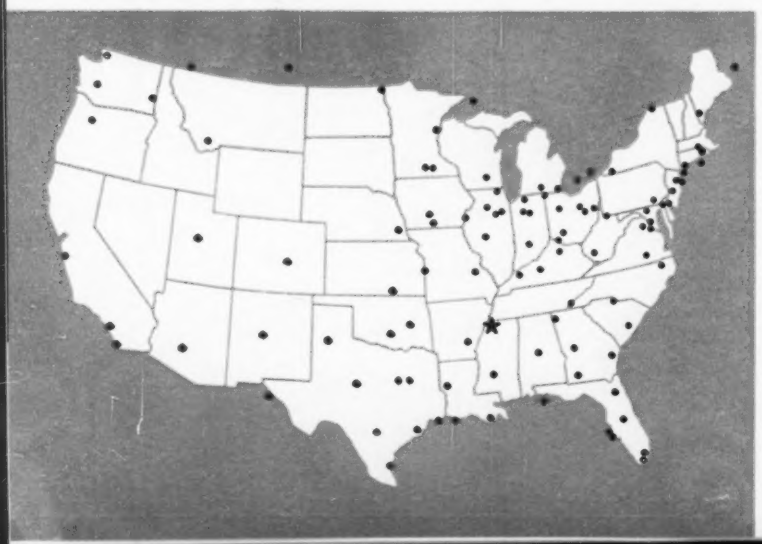

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FULLER PNEUMATIC CONVEYING SYSTEMS INCREASE PRODUCTION, CUT CONTAMINATION FOR GOODYEAR

Recent installation of specially engineered Fuller Airveyor® pneumatic conveying systems to handle pelletized rubber has helped Goodyear Tire and Rubber Company increase production. These systems are the latest Fuller design resulting from over 15 years experience in pneumatic conveying of rubber pellets. These completely enclosed automatic systems virtually eliminate contamination problems and greatly reduce the chance of loss due to spoilage.

Automated handling of crude rubber with Fuller Pneumatic Conveying Systems, in place of conventional rubber slab sheeting on a mill, is the key. One Airveyor system conveys the pelletized rubber from the pelletizer to a weigh station, a distance of 500 feet. Four more systems operate from the sink dump scales to inlet spouts of the finish-run Banburys.

All of these Airveyor pneumatic conveyors are of the vacuum type, employing positive pressure exhausters for air supply. Each conveying system is equipped with its own individual bag-type filter, automatic in operation, which provides for 100% visible dust retention. Exhausters and filters are located on the roof. A control panel permits manual or automatic operation of the entire handling system.

If you are handling dry, bulk, granular materials, a Fuller Conveying System application-engineered to your process can be equally advantageous. Look to Fuller, whose range of products coupled with experienced know-how offers you the best *single source* for solving pneumatic materials handling problems. Just call or write Fuller today outlining your problem—no obligation, of course. A-288 1954

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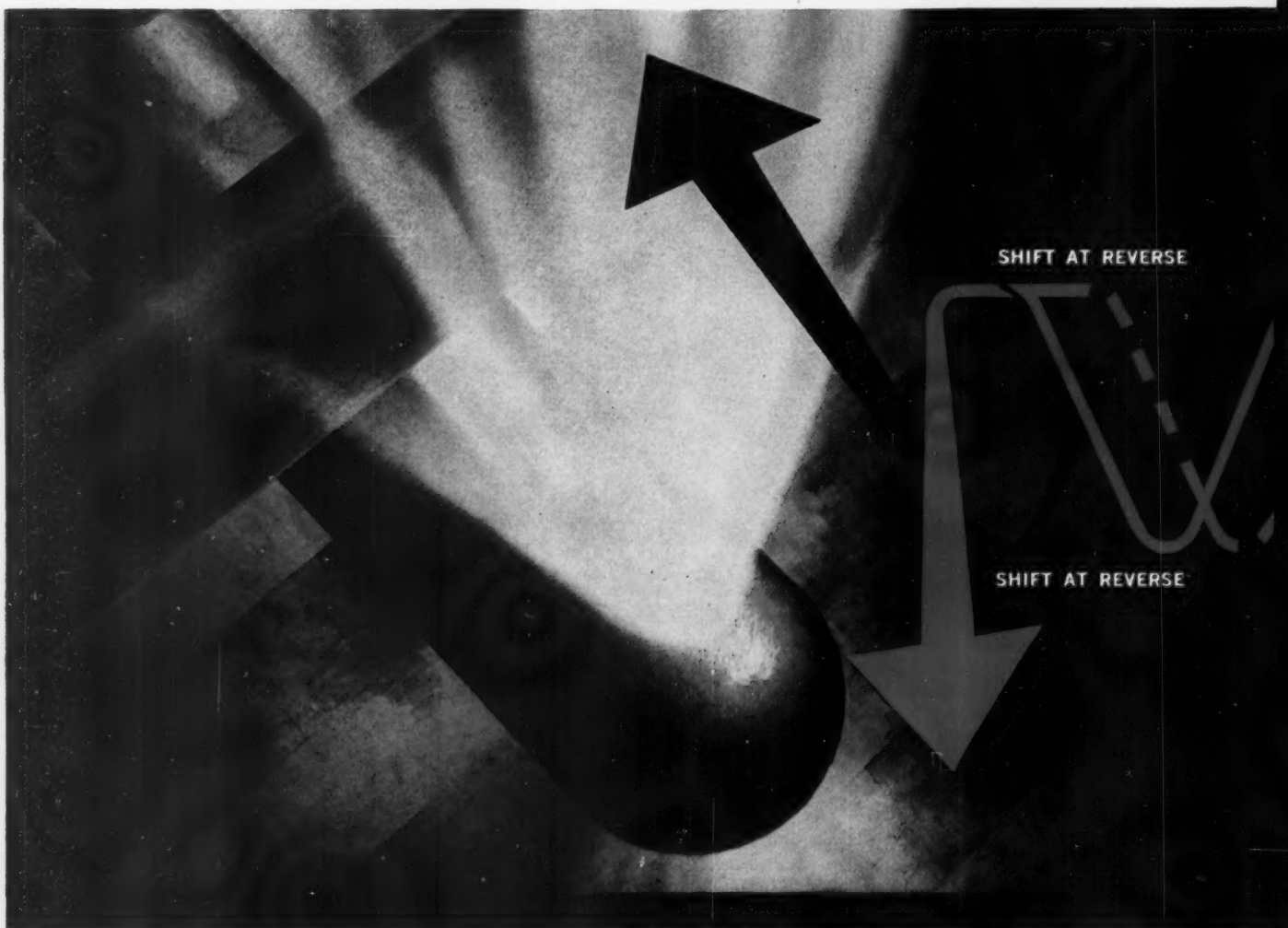
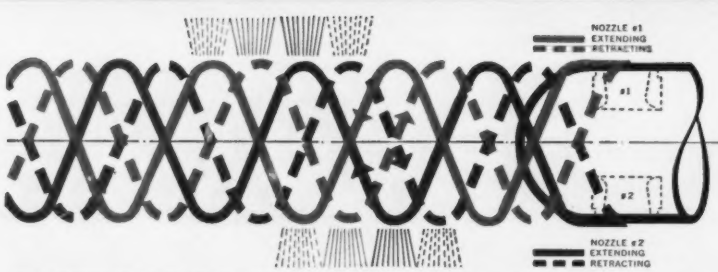
Get uniform, complete cleaning in those "tough-to-clean" zones. Specify Diamond's IK-300 Retractable Blower. The exclusive close-spaced IK helix assures a penetrating nozzle sweep every inch of travel regardless of tube bank arrangement and tube spacing. What's more, because sectionalized lance tube construction cuts deflection to a minimum, smaller boiler cavities are possible. In addition, a unique method of equalizing nozzle end-thrust assures "minimum-wobble" travel regardless of distance.

IK's are just part of the reason behind Diamond's established superiority in boiler cleaning systems. Add a complete line of cleaning equipment, an experienced, imaginative engineering staff and an unmatched service organization. No wonder thousands of utility and industrial power plants are equipped with Diamond Cleaning Systems — engineered and designed to provide you with more economical power.





Diamond

DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio • Diamond Specialty Limited, Windsor, Ontario

Heard Around Headquarters

MARJORIE ODEN,
Eastern Editor

Strike at Headquarters

Construction of the new Engineering Headquarters Building has hit a snag – two strikes. The steamfitters have been out for two months (at press time) and the elevator workers for one month. However, the strikes are not expected to delay the scheduled 1951 autumn completion date. Meanwhile, all available space in the headquarters building has been spoken for and the building fund is within $576,000 of its $8 million goal.

Good Times Can Be Bad

The Engineering Societies Personnel Service, which serves members of the Founder Societies, currently is operating at a loss. It is simply a case of too many engineers having jobs – and keeping them. The Founders have been asked if they would be willing to subsidize the Service through these trying times.

The reactions so far have varied. The American Society of Civil Engineers decided to provide a "reasonable subsidy" so current programs can be continued. The American Society of Mechanical Engineers voted to recommend that ESPS learn to live within its income or, failing that, discontinue the service.

Meanwhile, in Russia . . .

A member of the American delegation to this year's International Federation of Automatic Control in Moscow casually strolled over to take a look at a display of the latest Russian technical publications. There the delegate, Dr. J. G. Truxal, head of the electrical engineering department at Brooklyn Polytechnic Institute, discovered a translation of his own book on automatic control, which had only been published here a short time before. No such thing as royalties, in Russia, of course.

Plan First Exhibition

The American Institute of Chemical Engineers has limited past conventions to the business at hand – chemical engineering. But they have decided they were neglecting a profitable convention sideline – expositions.

So at the national meeting in New Orleans, February 26 through March 1, the AIChE will hold its first exhibition. It has hopes of selling 300 booths.

Advertising and EJC

The Engineers Joint Council newspaper, *Engineer*, may go commercial. As soon as the postal regulations are straightened out, the EJC publication will include advertising. A policy board hopes to have established ground rules for advertisements by the end of the year.

Losing Engineers

New York State now has fewer registered engineers than at any time since 1955, according to proceedings of the National Council of State Boards of Engineering Examiners. And the number has been declining steadily for the past four years. Latest available figures (1959) show 15,955 New York professional engineers, as compared to 16,893 in 1956.

New Association of Professions

A meeting is scheduled this fall to discuss the needs and possibilities of forming an association of the professions in New York State.

Several months ago, the president of the New York Medical Association called a meeting of engineers, pharmacists, architects, dentists, veterinarians, and attorneys. All attended except the architects. A representative of the Michigan Association of the Professions spoke.

According to MAP, inquiries have been received from 32 states, and MAP optimistically has prepared incorporation papers for a national association of professions.

Clearing House

A committee has been appointed by Engineers Joint Council to try to eliminate duplications in meeting dates among major engineering societies. The committee, made up of society officers in charge of technical planning, may expand the program in the future to "accredit" meetings. If this takes place, employers could be sure their men were not attending minor meetings

SILICONE NEWS from Dow Corning

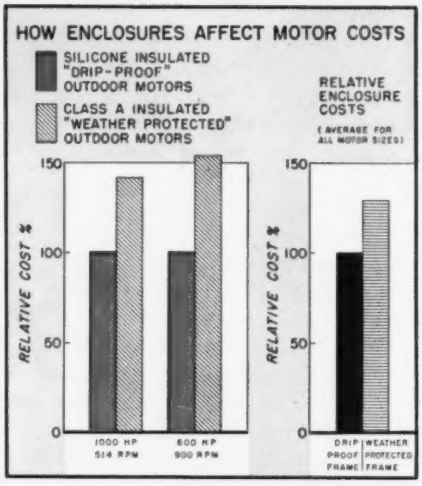
What Price Difference?

There's No Price Premium . . . Just Savings . . .When You Specify Silicone Insulation

For Outdoor Locations: You can save 30% and more on initial cost of form-wound motors by specifying silicone insulation systems made with Silastic, the Dow Corning silicone rubber. Here's why: 1) Silicone insulated motors are now available at no price premium; 2) The insulation system itself is self-protecting, shrugs off weather, humidity, corrosion, dust, even flooding. There's no need for elaborate enclosures that push motor prices up and up. The chart (right) shows how much you save by specifying silicone insulated open motors.

For Indoor Locations: Where ambient temperatures are high, where corrosive fumes or industrial contaminants are present; where relative humidity is pushing 100%; where motors are hosed down — in all these applications and others, too, expensive motor enclosures, and often expensive ducting as well, can be eliminated by specifying silicone insulation.

For Any Location: Silicone insulation systems increase motor service factor by as much as 15 to 30% because of their greater thermal stability. This increased service factor means there's no need to overmotor for occasional overloads . . . and suffer the power factor penalty of part loaded induction motors.



This chart shows one of the ways you save by specifying motors insulated with Silastic.

New brochure on Silicone Insulation. Write for your free copy. Address Dept. 2310.

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when they should be back at the office. The accreditation also would add prestige to the meetings.

PFEFES Anyone?

In mid-October, a new international organization will be complicating the engineering alphabet with the formation of PFEFES (Pacific and Far East Federation of Engineering Societies. The formative meeting is being held in Toyko following sessions of ICOLD (International Commission on Large Dams). Gail Hathaway, of the World Bank, is representing Engineers Joint Council in PFEFES.

Worried About Pollution

At the request of President Eisenhower and Arthur S. Flemming, Secretary of Health, Education, and Welfare, representatives of more than 300 national organizations have been asked to meet in Washington at the Sheraton-Park Hotel, December 12 through 15 to discuss water pollution. This will be the first such Federally sponsored Conference on Water Pollution, and more than 1000 persons are expected to attend.

In addition to engineers, others attending will be government personnel; industrial, farm, and labor groups; fish, game, and boating associations; and organizations in the fields of recreation, conservation, public health, and scientific research.

Flemming hopes that substantial agreement can be obtained on national goals for water pollution control and on the specific programs needed.

National Academy of Engineering

Engineers, long a little jealous of the intellectual status of the National Academy of Science, have formed a committee to look into the feasibility of forming a National Academy of Engineering.

The committee includes representatives of the Engineers Joint Council, the National Academy of Science, the Engineering Foundation, and Engineers Council for Professional Development. Funds for the study have been requested from the Foundation, and an executive secretary may be hired.

The approach is new, but the problem is familiar. It harks back to the old unity arguments. It is being suggested in some circles that an Academy might become a competitor unity group with E.J.C.

Long Terms

Recently elected officers of the American Society of Mechanical Engineers, with William H. Byrne of Byrne Associates as president, will get a six months bonus in their terms. Because ASME is changing from a calendar to a fiscal year, these officers will serve from December, 1960, to June, 1962.

Professional Soils Consultants

About two years ago, a group of consulting soils and foundation engineers met to decide whether to join the American Society of Civil Engineers, the Consulting Engineers Council, or the National Society of Professional Engineers.

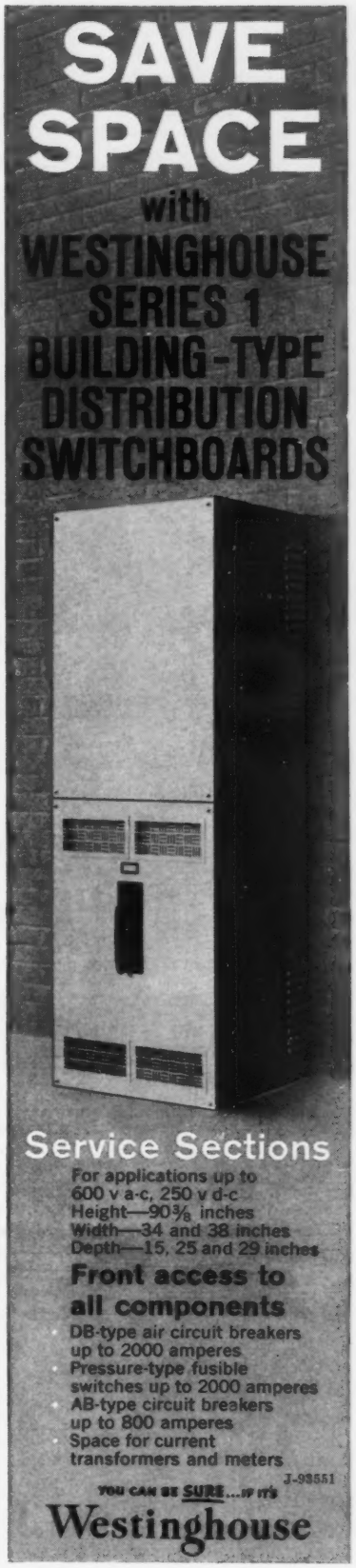
This group now is an ASCE Committee on Professional Practice of Soils Engineering, working as a task group of the Professional Practice Committee.

The soils consultants are trying to decide just how much of their work is professional and should, as such, be negotiated and not bid. Since some soils consultants have their own drill rigs, the problem gets complicated.

Currently, the committee, headed by William W. Moore of Dames & Moore, San Francisco, is drafting a "Guide for Soils Engineering." The proposed guide must go to the ASCE Professional Practices Committee, then to the Conditions of Practice Committee, and finally to the Board. After this, the committee will be disbanded.

Interstate Trade Barrier?

The New Jersey Association of Consulting Engineers and the New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with WESTINGHOUSE SERIES 1 BUILDING-TYPE DISTRIBUTION SWITCHBOARDS
Service Sections
For applications up to 600 v a-c, 250 v d-c
Height—90⅜ inches
Width—34 and 38 inches
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Front access to all components
DB-type air circuit breakers up to 2000 amperes
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AB-type circuit breakers up to 800 amperes
Space for current transformers and meters
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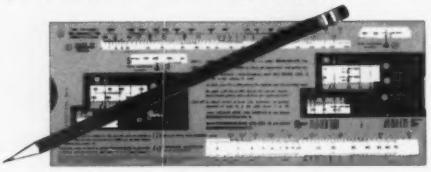
Now get fast answers to your water hardness problems

Handy new Morton Calculator gives you data at your fingertips when planning or improving hard water treatment systems.



With this amazing new calculator you can accurately determine for yourself the requirements of a water softening installation. You can quickly figure: the conversion of p.p.m. water hardness to grains per gallon hardness; the amount of exchange resin; the brine and salt requirements for maximum efficiency; and brine tank size and operating brine level adjustments.

You can make daily use of the calculator in selecting tank sizes for liquid volume problems. This Morton Ion Exchange Calculator comes to you free of charge.

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Jersey Society of Architects have banded together in an effort to get the state to use only New Jersey firms on its projects. In a letter to Governor Meyner, the qualifications of firms practicing in the state were pointed out, as well as practices of the State Highway Department and the Bureau of Construction. The Governor has indicated that every effort is being made to keep projects within the state.

While the motives behind this effort are not questioned, it raises the spectre of retaliation by the other 49 states. In an era when many U. S. consultants are seriously interested in foreign work, it is surprising that an important issue can be raised over the matter of interstate practice.

Corporate Practice Wins

By a vote of 37½ to 5½, the National Council of State Boards of Engineering Examiners approved the Model Law as drafted last Spring. The section on corporate practice (see "Legal Aspect," Page 50) went through despite objections from the Consulting Engineers Council, the American Institute of Consulting Engineers, and the American Society of Civil Engineers.

According to NCSBEE rules, anything presented must be adopted or rejected. No amendments are allowed, but the Committee on Uniform Laws was instructed to receive comments and suggestions with the view of possible revision from time to time.

At the Portland meeting, debate was limited to a definite period; only one person from an organization was allowed to speak; and those speaking were given a maximum of three minutes.

Urban Planning

Several months ago, the New York State Department of Commerce published a list of available urban planning experts, and described the work these men are allowed to do. Although many of the urban planners listed were not engineers, the work allowed in the State publication included many phases of engineering, and as a result the New York State Society of Professional Engineers protested.

The brochure has now been revised, and it now requires an engineer for engineering. The revised booklet states:

"In general, the Urban Planning Assistance Program, as administrated by this Department in accordance with the regulations of the Federal Housing and Home Finance Agency, does not envision a planning project to include work that would necessitate, under New York law, the services of a professional engineer or architect. However, some of the persons herein listed are professional engineers, or architects, having qualified for this list through their experience in community or regional planning. Where a program includes engineering work as defined by the Education Law, a licensed professional engineer or architect will be required to be responsible for that portion of the program."

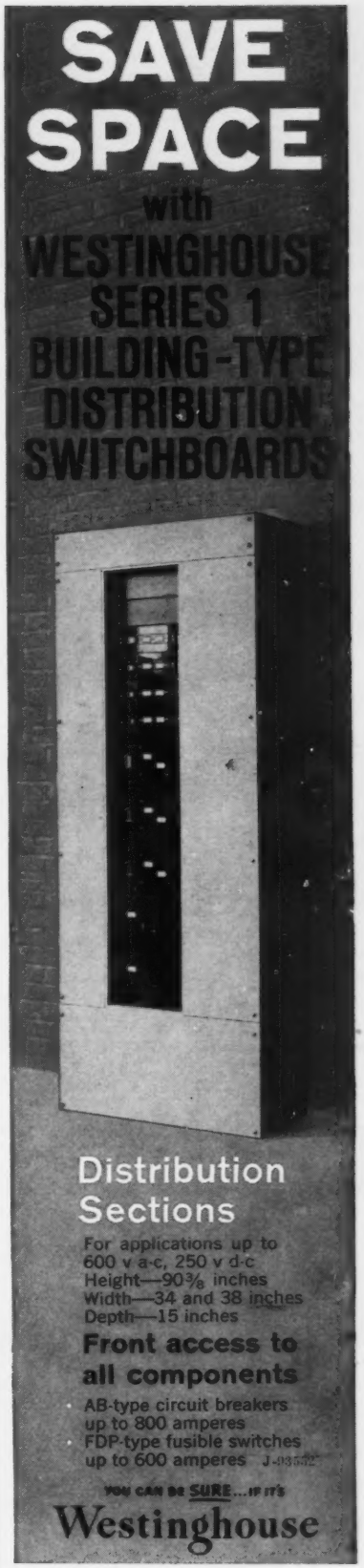
Manufacturers Get Together

Through the Air-Conditioning and Refrigeration Institute, 51 manufacturers of central air conditioning equipment are working on a program to guarantee equipment performance and eliminate confusing and misleading claims for cooling capacity – for both residential and commercial equipment.

All subscribing manufacturers must rate their equipment cooling capacity in terms of Btu's or equivalent tons of cooling. Horsepower and/or amperage are not descriptive of cooling capacity and are not admissible as ratings. In addition, all equipment covered is subject to random testing by an independent laboratory.

Chemical Introspection

In Northern California, American Institute of Chemical Engineers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Front access to all components
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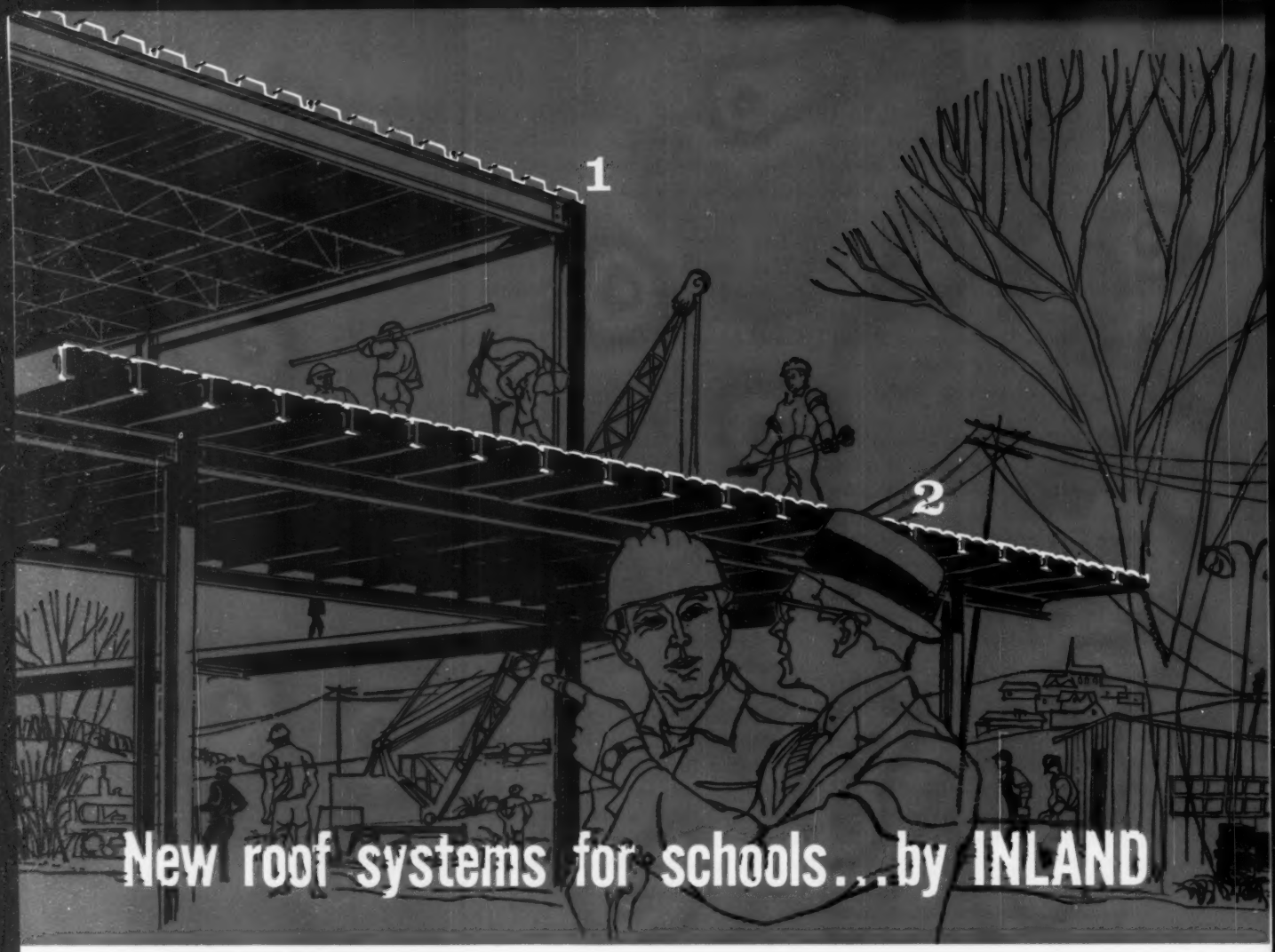
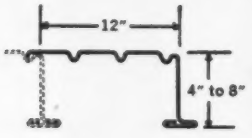


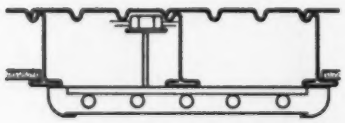
New roof systems for schools... by INLAND



T-STEEL — New! Galvanized. For clear spans to 32'0". Adaptable to acoustical and flush, luminous ceiling treatments. Provides superior diaphragm to transmit seismic and wind loads.

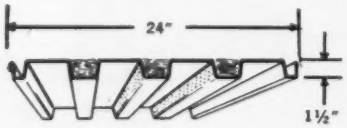
Ceiling Treatments with T-Steel Deck

Standard Tile or Board — Light Diffuser



Surface-Mounted Fixture

Lath-and-Plaster Fireproofing



TYPE B ACOUSTIDECK — For purlin spacings from 6' to 10'. Uses minimum of 1" rigid insulation board.

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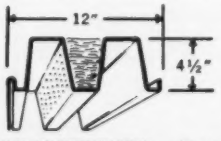

TYPE C ACOUSTIDECK — For purlin spacings from 10' to 20'. Uses minimum of 1½" rigid insulation board.

Complete structural systems that broaden your latitude in planning ceilings, lighting, acoustics —within realistic budget boundaries

1. Acoustideck for gymnasiums, other activity areas

Combines steel roof deck and acoustical ceiling with Noise Reduction Coefficient of .70.

Erected fast in any weather that a man can work. Interesting ribbed underside provides an attractive ceiling.

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Especially suitable over classrooms of 26' to 32' spans —or other areas where you want an attractive unbroken ceiling surface.

You can use various types of acoustical tile — provide a flush, luminous ceiling — or leave the underside exposed and painted.

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members were queried on current society and professional issues. The findings are as follows:

¶ Thumbs down on compulsory registration by 70 percent.

¶ Although 78 percent are against chemical engineers joining unions, only 70 percent thought a union membership is incompatible with professional status.

¶ AIChE was rated as satisfactory or better in supporting chemical engineering education, assisting and inspiring chemical engineering students, aiding professional development, cooperating with other engineering societies, maintaining a high caliber of professional publications, and high ethical standards.

¶ The members said AIChE has room for improvement on counseling recent graduates and enlightening the public on chemical engineering.

Working Together

The New York Association of Consulting Engineers and the New York City Chapter of the American Institute of Architects have agreed to form a joint committee to work out current and future problems. One of the first items on the joint group's agenda is the formulation of an approved method for architects to use for selecting a consultant on a professional basis.

Ethics Revision Moves Slowly

The American Society of Civil Engineers' revised Manual of Ethics (see March CONSULTING ENGINEER) is plodding through channels. It came up for discussion at the Reno convention and was sent back to committee for further study. Now it is scheduled for discussion again at the Boston convention in October.

Taxes and Little Cars

Internal Revenue Service officials have refused to exempt a new small electric car from the manufacturers excise tax although it has limited speed and range. "The fact that it is impractical to use on freeways or main highways does not characterize it as a 'nonhighway vehicle' for tax purposes," the IRS says.

The car is 9-ft long, 3-ft wide, and weighs about 800 pounds. It is designed for use on city streets.

Midwest Concrete Board

The architects and the civil engineers in Kansas City recently got together and formed a Concrete Industry Board of the Midwest, with aims similar to that of New York City's CIB.

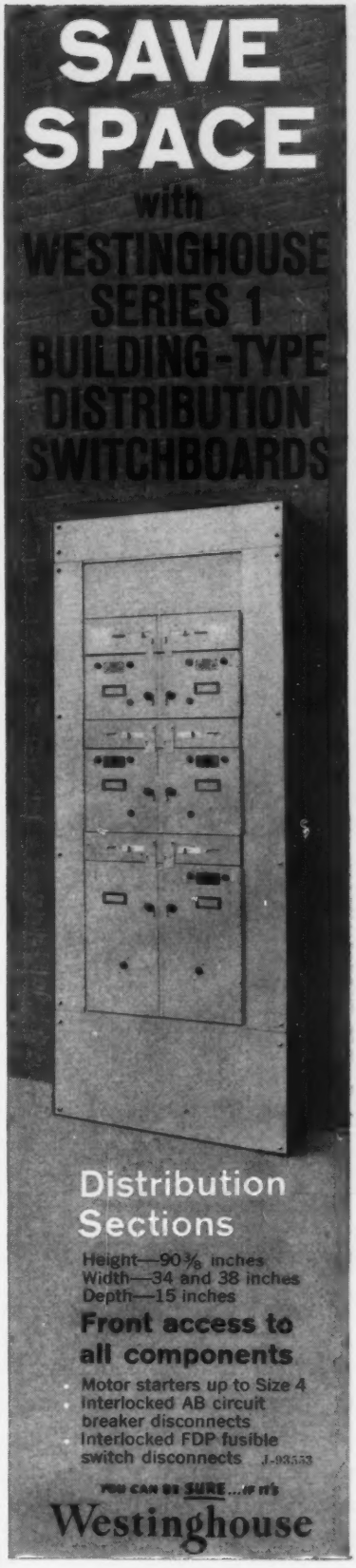
More than 100 people attended the initial meeting, which was sponsored by the Kansas City chapters of the American Institute of Architects and the American Society of Civil Engineers. Aim of the new board is to insure the quality of construction by recommending standards of design criteria, materials, testing procedures and construction practices, and governing regulations.

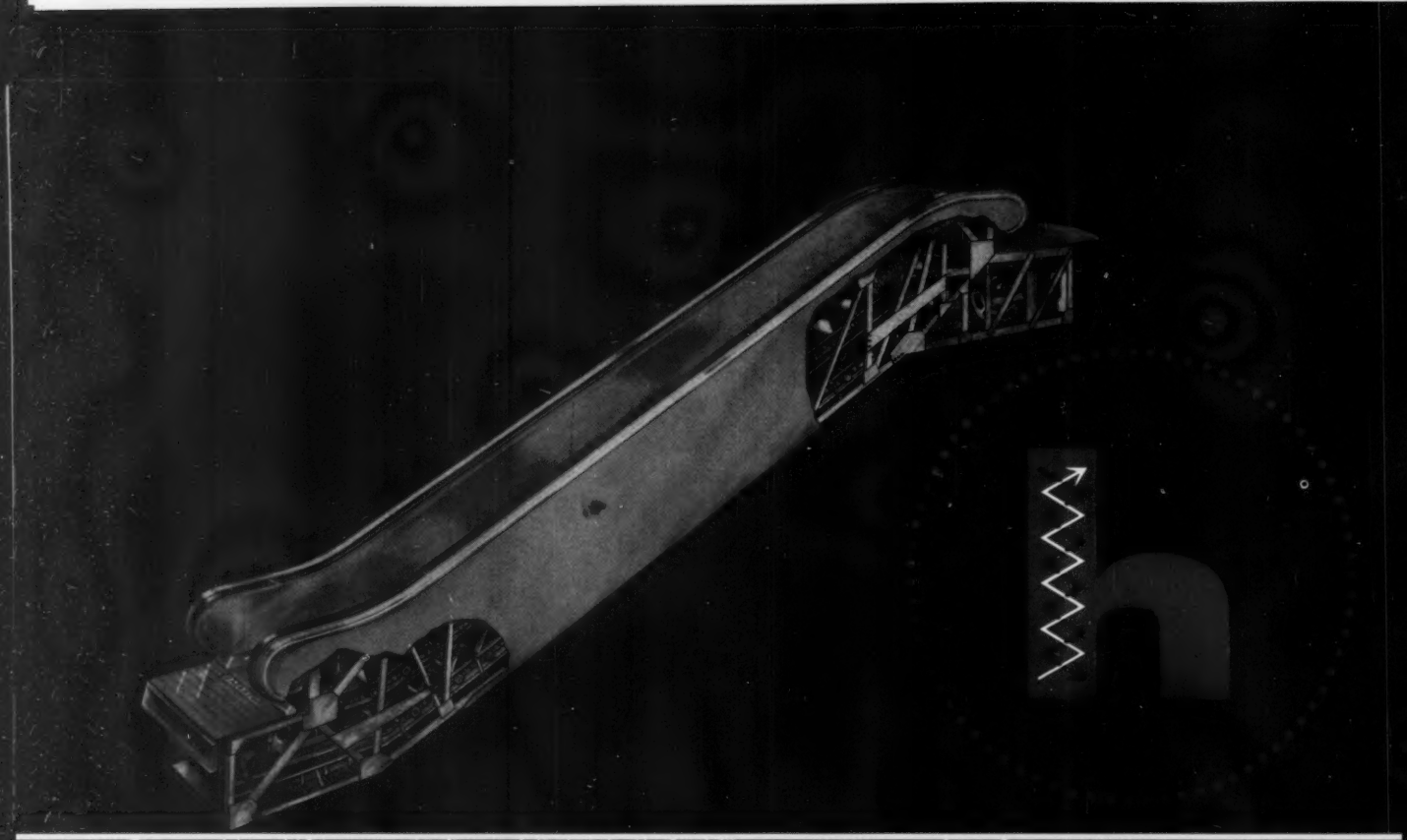
Standards Approved

Thermal and mechanical design standards, which have been in preparation for about 10 years, will be released this fall by the Fuel Oil & Water Heater Manufacturers Association. The standards will cover below water line fuel oil heaters, instantaneous water heaters and convertors, ethylene glycol solution convertors, steam convertors, and convertor and heat exchangers.

Shields on CEAC Board

Morton K. Shields, consulting mechanical engineer, of Van Nuys, California, has been appointed to the board of directors of the Consulting Engineers Association of California. Shields fills the board vacancy created by the resignation of Peter V. H. Serrell. Shields has been active in the inter-association programs maintained by CEAC for technical liaison between the many engineering professional groups in the Los Angeles area. ▲▲





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The successful combination of these three key factors provides a practical answer to passenger transportation in a wide variety of buildings. Choose from three standard nominal widths: 25″, 32″ and 48″, with corresponding rated capacities of 3000, 5000 and 8000 persons hourly. Installation and operation of the new Haughton Type H assures economies you will want to consider, too, in new construction or remodeling. Maintenance is simple and inexpensive. Consult your Haughton representative soon. The new Type H may be your answer to handling big traffic loads in a minimum of building space.

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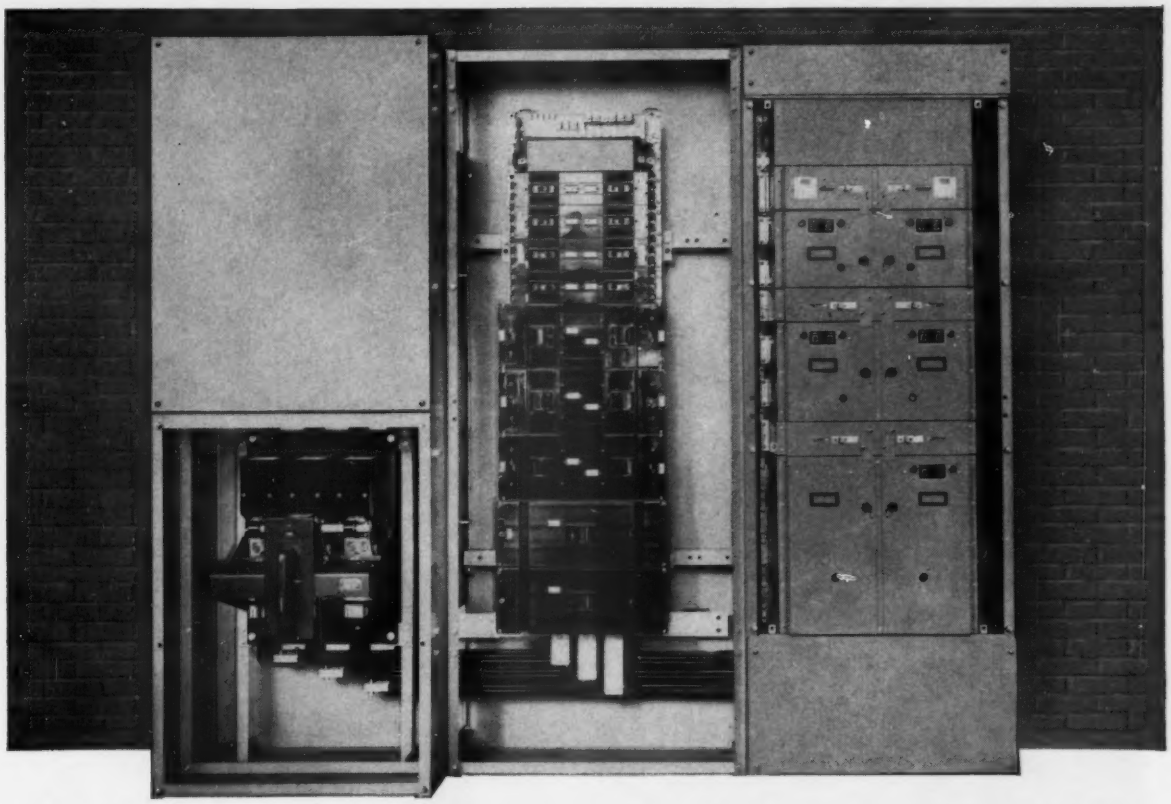
NEW, COMPACT WESTINGHOUSE SERIES 1 BUILDING-TYPE DISTRIBUTION SWITCHBOARDS



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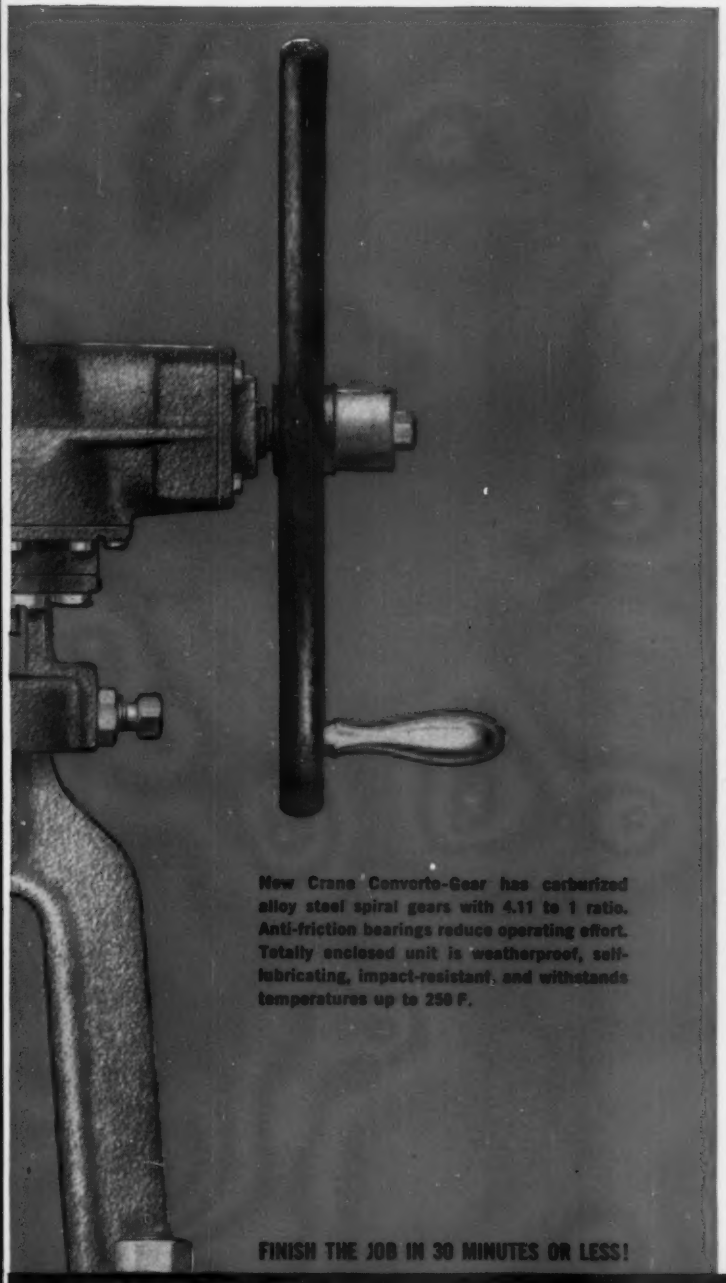
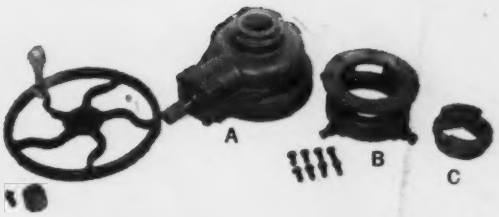


New Crane Converto-Gear has carburized alloy steel spiral gears with 4.11 to 1 ratio. Anti-friction bearings reduce operating effort. Totally enclosed unit is weatherproof, self-lubricating, impact-resistant, and withstands temperatures up to 250 F.



Only three parts needed to convert your OS & Y valve to gear operation: (a) Crane Converto-Gear Operator, (b) adapter for mounting operator on valve, (c) yoke sleeve adapter. Handwheel and mounting bolts furnished with conversion kit.

Now you can convert to rapid, easy gear operation on many of your Crane iron and steel gate valves without removing them from the line! Changeover is simple and fast with Crane's new Converto-Gear Operator.

Your Crane Distributor can give you complete information on this brand-new idea in gear operators for gate valves. The Converto-Gear is standard and universal, readily mounted on Crane iron and steel gate valves in sizes from 6-inch to 36-inch, in outside screw and yoke or non-rising stem patterns.

And new orders for gear operated valves can be filled with unprecedented speed because the Converto-Gear can be supplied on valves right from stock. No special yoke castings or brackets are needed . . . just the basic gear operator and a simple two-piece adapter.

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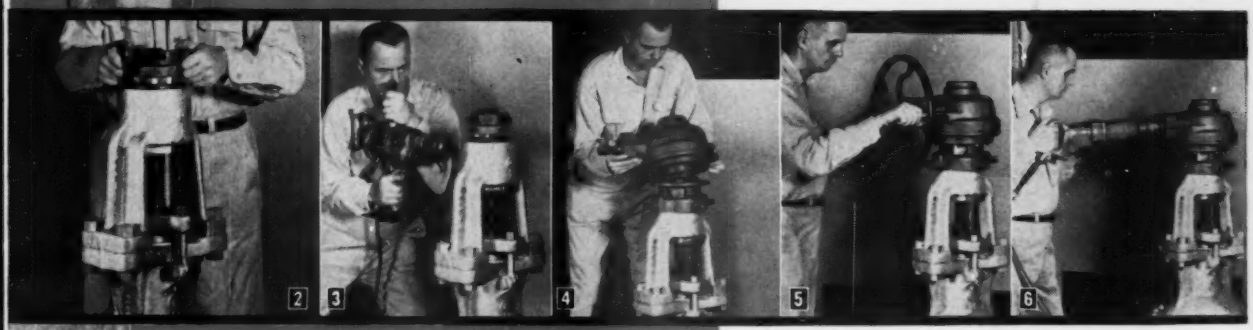
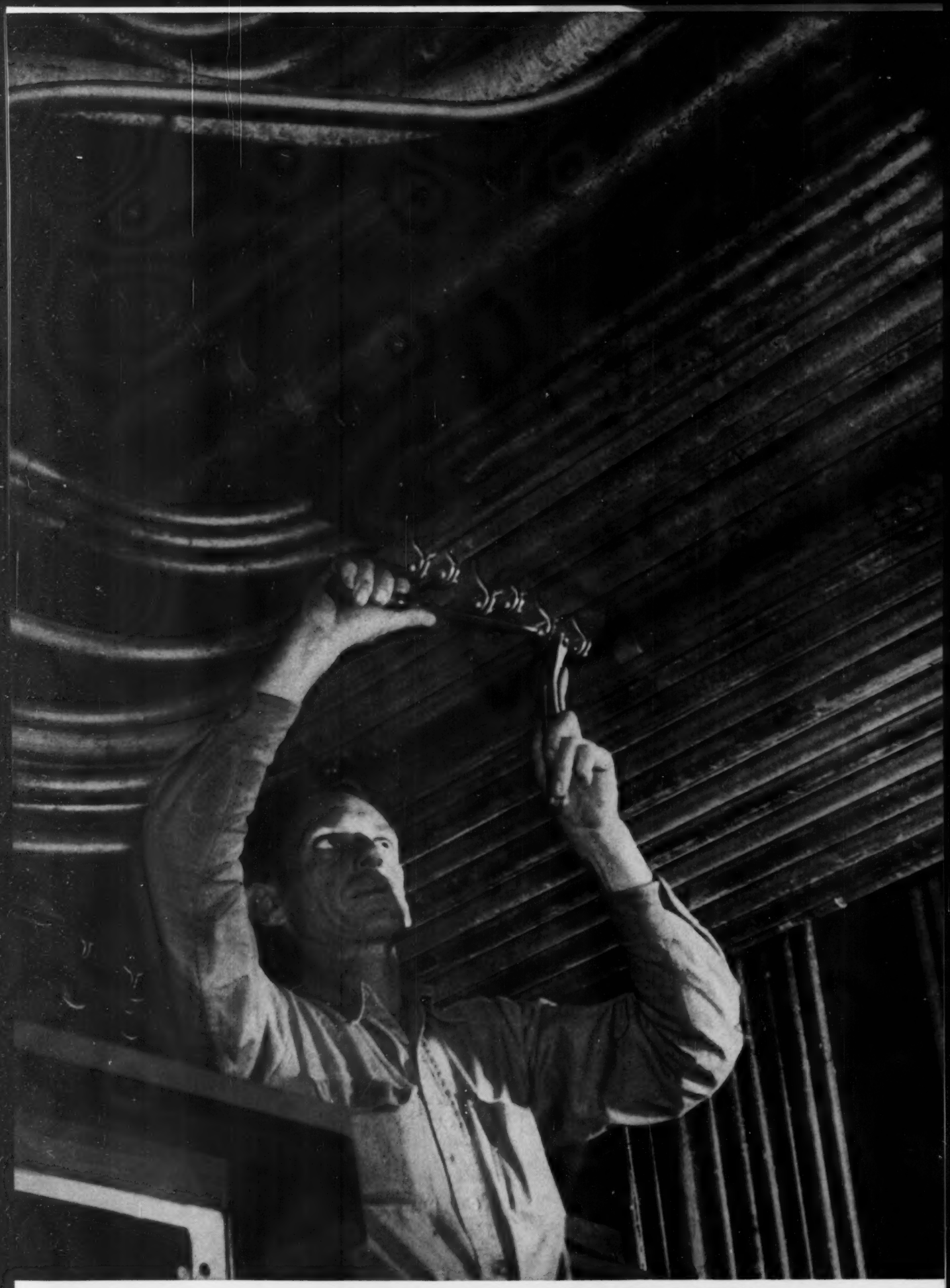
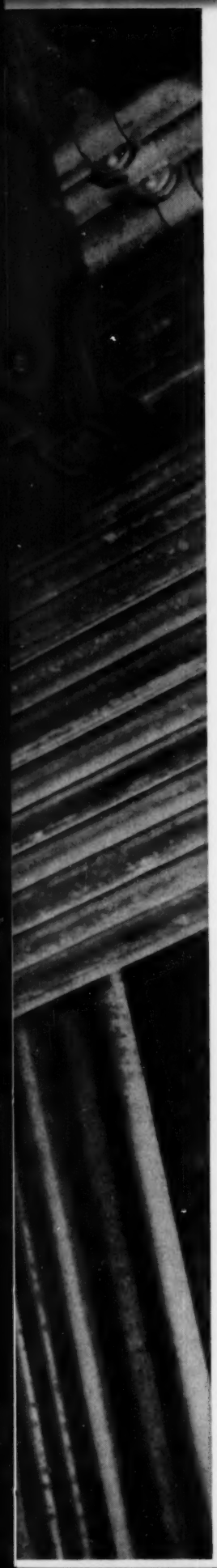


To convert your OS & Y valve, (1) remove the handwheel, (2) mount the yoke sleeve adapter, (3) countersink 4 holes for the Converto-Gear adapter, (4) bolt the adapter in place and attach your Crane Converto-Gear Operator, (5) and you're ready for smooth, manual operation, (6) or fast operation with an air or electric power operator.





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SOLUTION:

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Shutdowns caused by power failures usually entail significant losses; loss of labor during repair time . . . and in some cases, loss of goods in production. This is not to mention cost of repairs, both in labor and in cable. Many such power failures are the result of overloaded circuits—obsolete cables unable to handle the increased loads of today's stepped-up production, or the anticipated needs of tomorrow.

Is your plant's high-voltage electric power system limiting you? Make a careful check of it to find out. Then, if out-of-date or inadequate wiring is a problem, see your Anaconda distributor or the Man from Anaconda—about high-voltage butyl-insulated Anaconda Durasheath.*

High-voltage Anaconda Durasheath (5 kv and up) has been designed to give long life, dependable service. It is insulated with Anaconda Butyl (AB)—resistant to ozone, moisture, heat. Its tough neoprene jacket resists weather, soil conditions, abrasion and mechanical injury.

You can run Anaconda Durasheath from underground to overhead, and into ducts in one continuous run—without splicing. It is light, flexible, easy to handle, economically installed. For further information about Anaconda Durasheath write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Trademark

Durasheath has Anaconda Butyl (AB) rubber insulation for

- extra high resistance against ozone
- exceptional moisture resistance
- 22% more current-carrying capacity than 70 centigrade insulation

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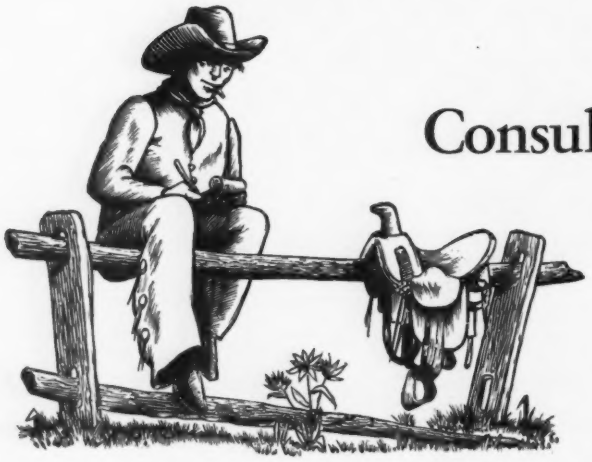

Report from the West Coast

Consulting Engineers Fight Secondary Boycotts

RALPH S. TORGERSON
West Coast Editorial Representative

THE CIVIL engineering firm of Sholders, Tanner, Marquardt and Associates, Inc., Escondido, California, recently won an important decision from the National Labor Relations Board which ordered Local 12, Operating Engineers, AFL-CIO, to cease and desist the picketing of projects on which the firm was supervising construction. This decision takes on increasing importance nationally as this might be considered a test case to determine the vulnerability of consulting engineer firms to secondary boycotting activity by unions.

During the latter part of April, the union picketed a street improvement project for the City of Escondido handled by C.K.F.M. Corporation, protesting the presence on the job of the engineering firm's employees as nonunion workers. The engineering firm was engaged in construction surveying work on the project for the City of Escondido. Picketing caused work stoppages to occur on several occasions.

Sholders, Tanner, Marquardt and Associates charged that the picketing constituted an unfair labor practice under the Federal Landrum-Griffin Act and proceeded to take legal action before the National Labor Relations Board to cause the picketing to be stopped.

Legal counsel for the firm filed charges with NLRB of unfair labor practice pursuant to sections of the Act which deal with acts of secondary boycotting. The counsel also filed a Petition for Election among the engineering firm's employees. A vote of the employees showed a preference for no union representation. In a letter to the National Labor Relations Board, the legal counsel for the union then withdrew any claim by the Operating Engineers to representation or any request for a contract.

The attorneys for the engineering firm pointed out that statements made by the Operating Engineers' agents during the course of the dispute, which were obtained in the form of affidavits to both the Board and legal counsel for the engineering firm, indicated the chances were slight for any recurrence of any type of picketing during the existence of the current contract between the Operating Engineers and other employers in the same field in this area. As a result of this action, it was believed the NLRB would issue an immediate injunction against the union for illegal picketing upon filing of proper documents with the Board.

Active Opposition from CEAC

The action of the National Labor Relations Board in this case points up the very important protection available under the Landrum-Griffin Act against secondary boycotting. This will be largely lost if the Kennedy-Thompson, S-2643 and HR-9070, Common Situs bills become law. The Consulting Engineers Association of California has been actively opposing the passage of these bills.

In telegrams to Senators Kuchel and Engle, the Association expressed its "disapproval of this or any other legislation which would expose the construction industry, and indirectly the professional engineers in private practice, to the devastating whims of secondary boycott action. With so many jurisdictional problems yet unresolved within AFL-CIO, it would be totally unfair to throw the door open to unscrupulous local jobsite picketing." The Association pointed out to its members that passage of the Kennedy-Thompson bills could ultimately result in leading the union organizer right into the drafting room and engineering department. It could spell compulsory union membership for every worker associated with the construction trades.

In California, Oregon, and Washington, consulting engineers are not faced with the problem of labor union secondary boycotts and picketing on state work as there have been only a limited number of design and supervision contracts awarded to consultants in private practice, but this problem is very

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likely to arise on many contracts involving municipal and local government work and, of course, is always an impending threat on private construction jobs.

If the engineering work did not go beyond design, conflict with the unions would be less apt to arise. However, the attempt by unions in California to require a union label on drawings, if successful, would have resulted in an interminable number of cases where picketing and other forms of secondary boycott could have arisen even though the engineering work was limited to design.

Consultants Must Supervise

It is not enough to secure design contracts alone; supervision by the engineer consultant is essential to follow through the work to completion to assure the client that the job is being carried out in accordance with plans and specifications. Consulting engineers cannot evade this responsibility to avoid possibilities of labor conflict.

The entire engineering profession should be alerted to the dangers involved in the Kennedy-Thompson Common Situs bills. As this is a national election year, timid members of Congress can be expected to vote for legislation which will favorably influence the greatest number of voters.

Although the most imminent danger of secondary picketing confronts the contractors in the construction industry, if the Common Situs bills become law, consulting engineers and architects should not feel that "this can't happen to me." The Architects and Engineers Conference Committee of Los Angeles recently held a meeting at which this subject was given top consideration. If the consulting engineers, as individuals and through their associations, band together with the larger construction contractor groups to make known to members of Congress their objection to these dangerous bills, it may be that the bills can be defeated. ▲▲

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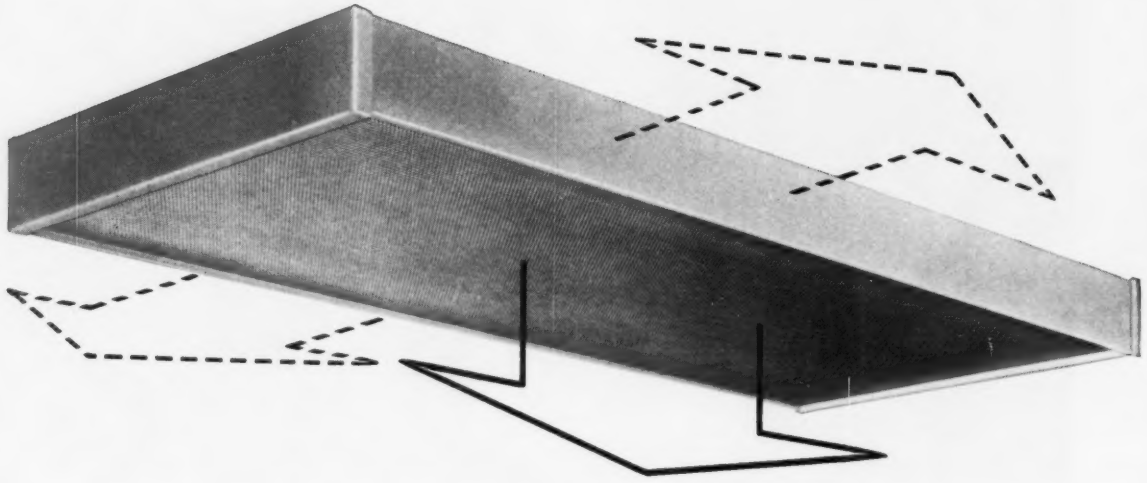

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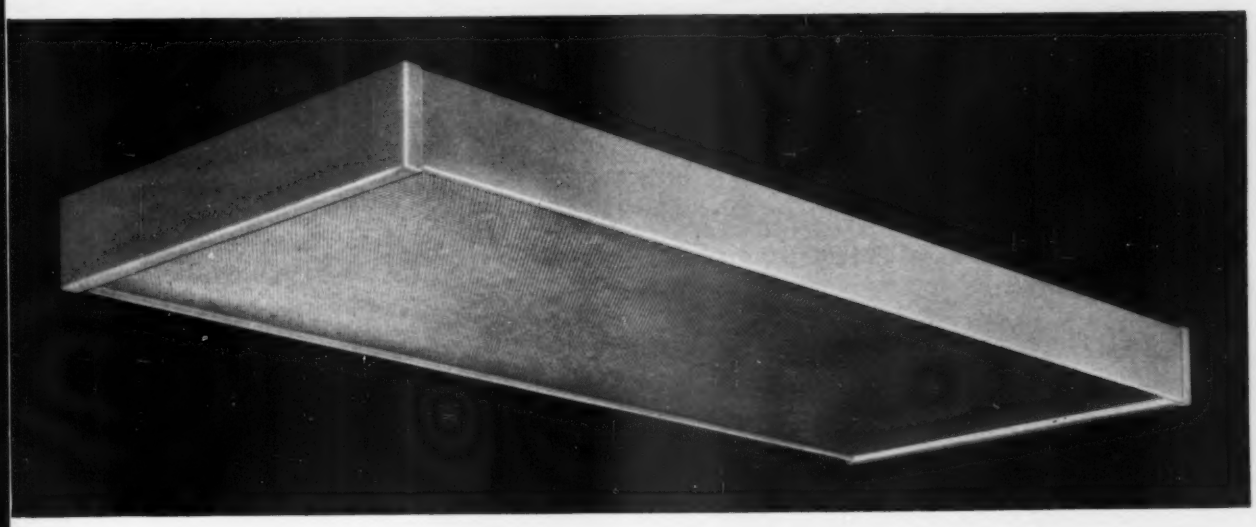

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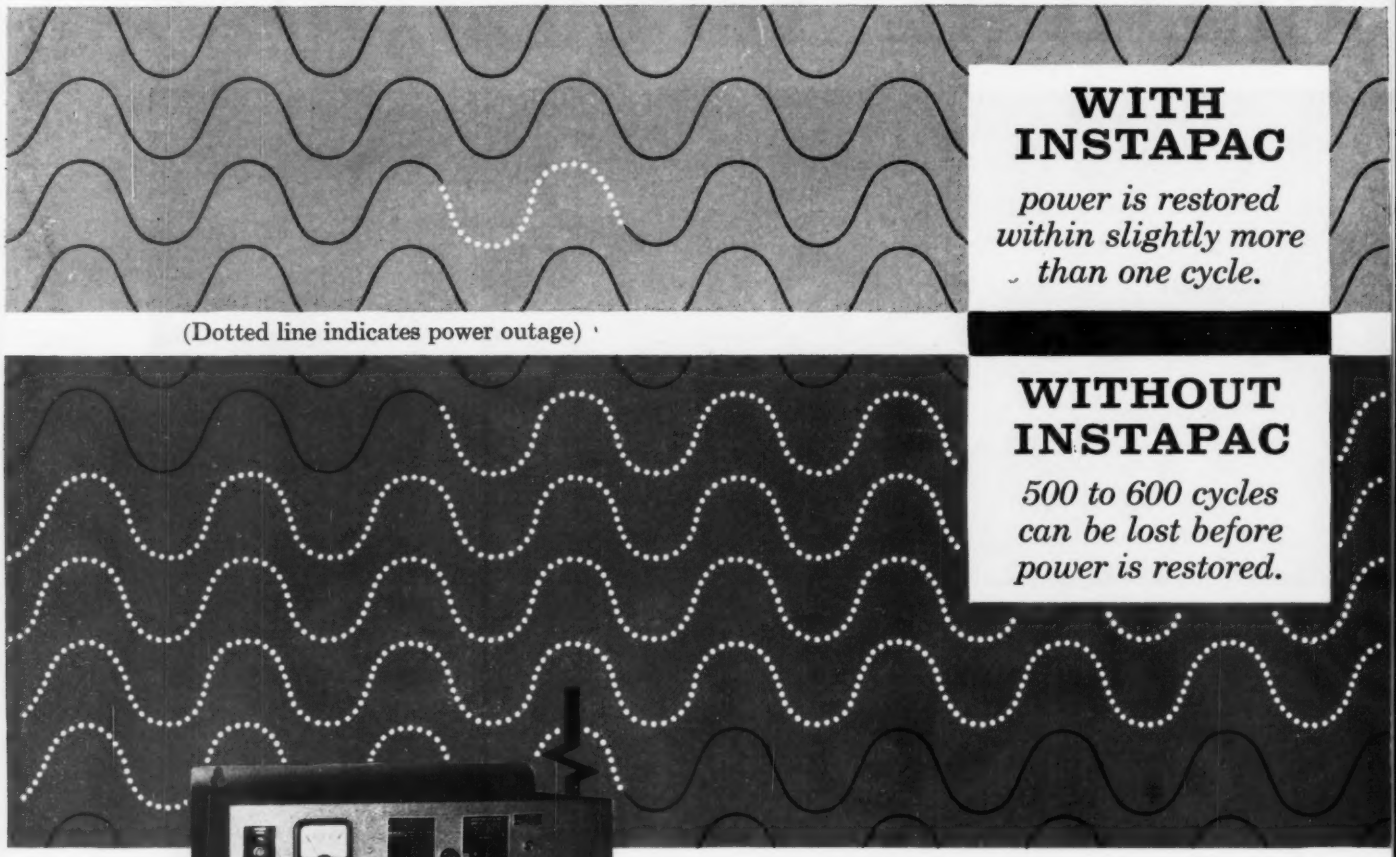

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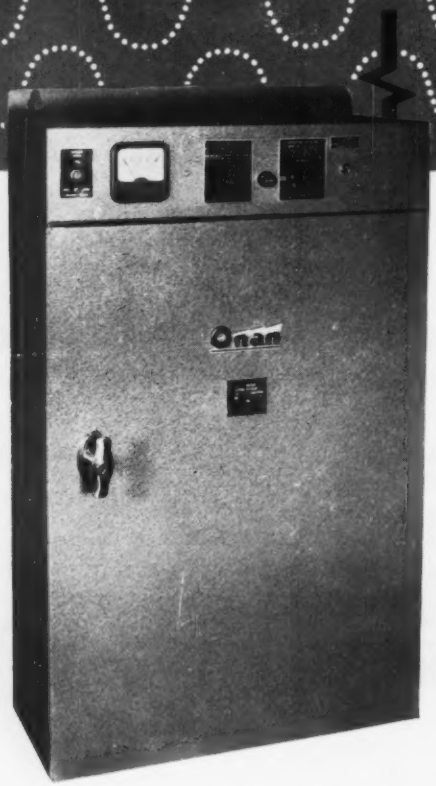

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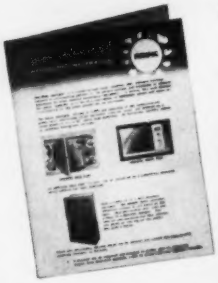

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Our Authors

Ellis L. Armstrong is a career minded civil servant who spent eighteen years with the U. S. Bureau of Reclamation. Much of this time he was in the field on dam, railroad, highway, and other projects in the western states. Three of these years were spent in the Chief Engineer's office in Denver, where he was in charge of a design section.

In 1953, Armstrong went to Egypt on a land, water, and transportation development project. He also served as a consultant to the Egyptian Government on the High Aswan Dam.

A year later, he joined a firm of consulting engineers working on the St. Lawrence Seaway. He was first a project engineer, then construction manager, and finally assistant project manager.

After a tour of duty as Director of Highways for the State of Utah, during which he reorganized the State's highway department and got its accelerated highway program underway. Armstrong was sworn in as Commissioner of Public Roads, U. S. Department of Commerce, in October, 1958.

An active organization man, Armstrong is a Fellow in the American Society of Civil Engineers, and a member of the American Association of State Highway Officials, U. S. Committee on Large Dams, American Road Builders' Association, and Western Association of State Highway officials. His article on the Bureau of Roads' activities outside the U. S. appears on page 93.

Leonard G. Parks and Chester J. Danowitz have collaborated to tell the story of what is going on above our sleek, modern office building ceilings. The article begins on page 98. Parks is a supervising electrical engineer in charge of illumination work for Ebasco Services, Inc. He has been with Ebasco for 14 years, ever since a four year tour of duty with the Army during World War II. A graduate of the State University of Iowa, Parks first earned a BSEE and then obtained a masters degree with a major in illumination. He is a member of Sigma Xi, chairman of the IES Industrial Lighting Committee, Chairman of the ASA Committee on Industrial Lighting, member of IES RQ & Q Committee, and a member of the U. S. National Committee of the International Commission on Illumination.

Chester J. Danowitz is a supervising mechanical engineer in charge of heating, ventilating, and air conditioning work at Ebasco. He has been with the firm for 13 years, following a tour of duty with the U. S. Navy. He is a graduate of the Polytechnic Institute of Brooklyn, with a BME received in 1939. Danowitz is a member of the ASHRAE and a member of the Research Advisory Committee (RAC) on Heat Pumps. His entire career has been spent in the heating, ventilating, and air conditioning field. The majority of his work has been in design and consultation work for power plants, office buildings, and industrial plants.

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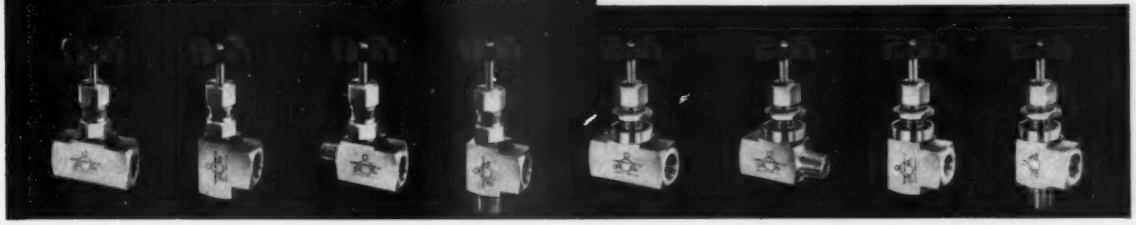

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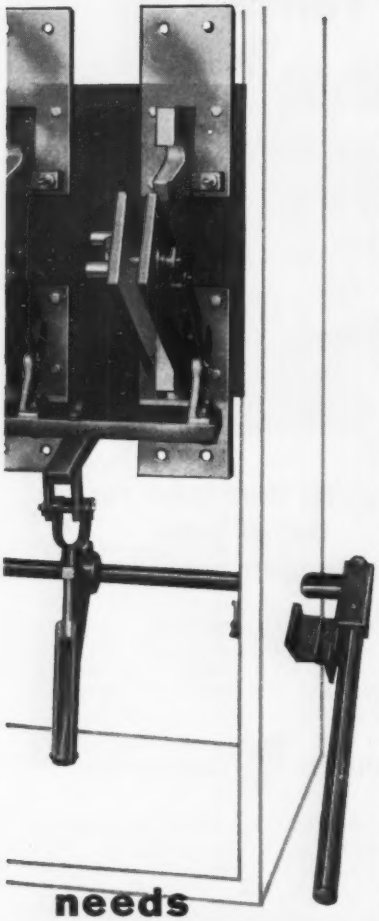

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PHILADELPHIA 22, PENNA.

George W. Poulsen, Jr. has long been interested in contract documents and has been very active in the work of Consulting Engineers Council in this field. His article appears on page 104. Poulsen was educated as both accountant and civil engineer, receiving his BSCE from the University of Utah in 1943. He was elected to both Tau Beta Pi, and Phi Kappa Phi.

Poulsen has a broad engineering background, having worked for a number of consultants, for industry, and for government. He also taught at the University of Utah. He opened his own office in 1948.

Currently, Poulsen is a member of ASCE, APWA, AWWA, and the Construction Specifications Institute. He is a second vice president of Consulting Engineers Council and a past president of the Intermountain Institute of Consulting Engineers.

Jack N. Steketee received his BSCE from the University of Michigan in 1941. He then joined Giffels and Vallet, Inc., and a short time later began a three year naval career. He returned to G & V in 1946, and left in 1949, with Alfred H. Samborn, to form the firm of Samborn, Steketee, Otis and Evans.

Recently, the Toledo Section of the American Society of Civil Engineers recommended Steketee for the Ernest E. Howard Award, as a result of his work on "Crestview of Ohio." The two way voided lift slab design, used on this project, is covered in his article on page 125.

Steketee is a trustee for the Toledo Society of Professional Engineers and the Engineering Society of Toledo, and is an active member of the Toledo Chapter of the ASCE. He is a member of the Metropolitan Affairs and Industrial Development Committee of the Toledo Area C of C.

Zusse Levinton is an associate partner of Tippetts-Abbett-McCarthy-Stratton, and has been head of the structural department for 14 years. He has been involved in projects on bridges, buildings, waterfront and marine structures, and pioneer developments in atomic engineering and space engineering. From the latter area he has drawn material for his article about engineering on the moon, which appears on page 86.

Levinton is a graduate of the University of Saskatchewan and a member of the ASCE, American Concrete Institute, and the American Welding Society. He is the author of several technical papers and co-author of chapters in Abbett's "American Civil Engineering Practice." A professional engineer, Levinton is registered in the State of New York. ▲▲

YARWAY Y news briefs

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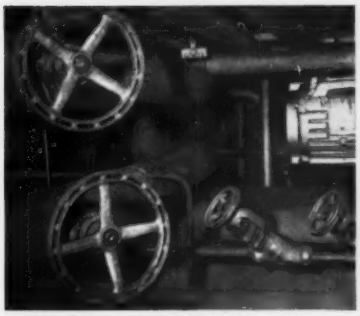
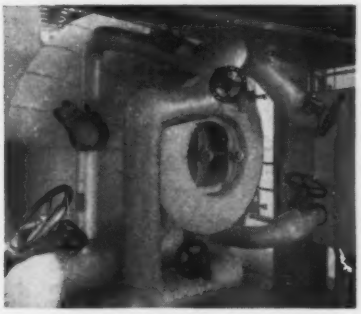
4. Unique seat design with thermal compensating groove that prevents distortion during assembly welding and when welding valve into line. Also permits perfect seating of disc for tight seal. Integral seat is stellite-faced.
5. One-piece forged chrome-moly steel body and yoke.
6. Easy-grip, ventilated handwheel—makes operating a "breeze".

More details—and list of users? Write Yarway. Ask for Bulletin B-454.

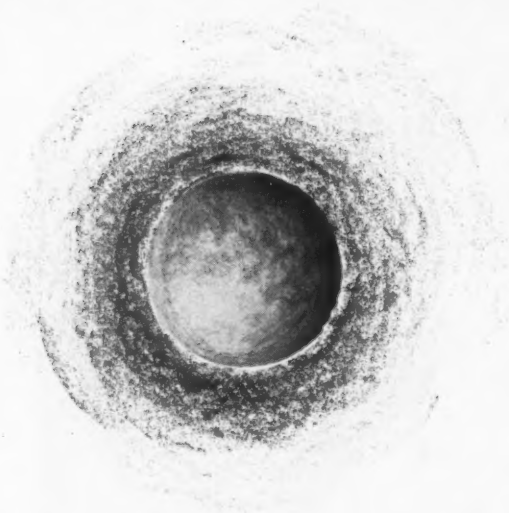


Four of many Yarway Welbonds installed in large eastern public utility plant. Steam pressure 1850 psi; temperature 1000°F.

Four Yarway Welbonds on main steam line to turbine at southern power plant. Press. 2310 psi; temp. 1000°F. Over 100 Welbonds here.



Six of 900 Yarway Welbonds at southwest utility. Boiler drum pressure in this plant—2150 psi; superheat temperature 1005°F.



ZUSSE LEVINTON
Associate Partner
Tippetts-Abbott-McCarthy-Stratton

Engineering For The Moon

ALTHOUGH THE MOON is our close neighbor and has been observed by scientists for several centuries, there is still much that is unknown about it, and much that we think we know will have to be verified by the first visitors from earth. However, there are sufficient facts on hand for us to make reasonable deductions and reach important conclusions. Getting to the moon and back is one problem – a problem primarily of mechanics and electronics. Occupying the moon is quite another matter – a matter of civil engineering and construction involving a completely different set of constants for our earth-bound equations. Some idea of the differences involved in the design calculations are suggested in the table comparing earth and moon characteristics.

The topography of the moon is rugged, with high mountain ranges and precipitous cliffs, generally arranged in circles called "craters," and flat, apparently smooth, areas or plains called "seas." Optical and thermal measurements indicate that the hard, rocky surface of the moon is covered to an undetermined depth by some kind of a spongy or granular material variously referred to as slag or dust. The exact nature of this cover material as well as that of the underlying rock is important to engineers, for it will determine the types of supports and foundations for structures. Sampling and probing of this material will be among the tasks of the first visitors. Before that, however, valuable information may be gathered by photography from close orbiting lunar satellites and soft-landed instruments.

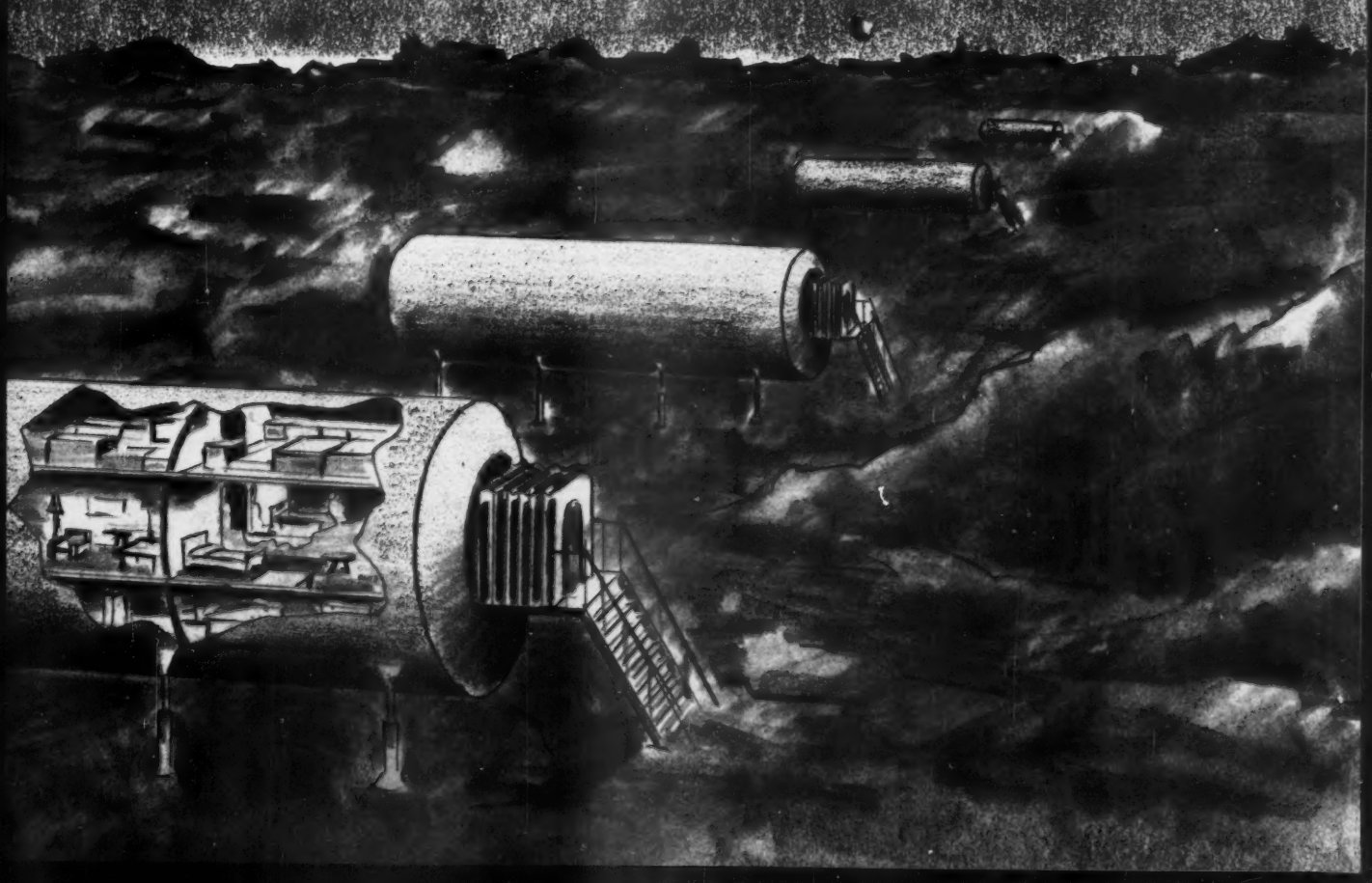
COMPARATIVE DATA FOR THE EARTH AND THE MOON

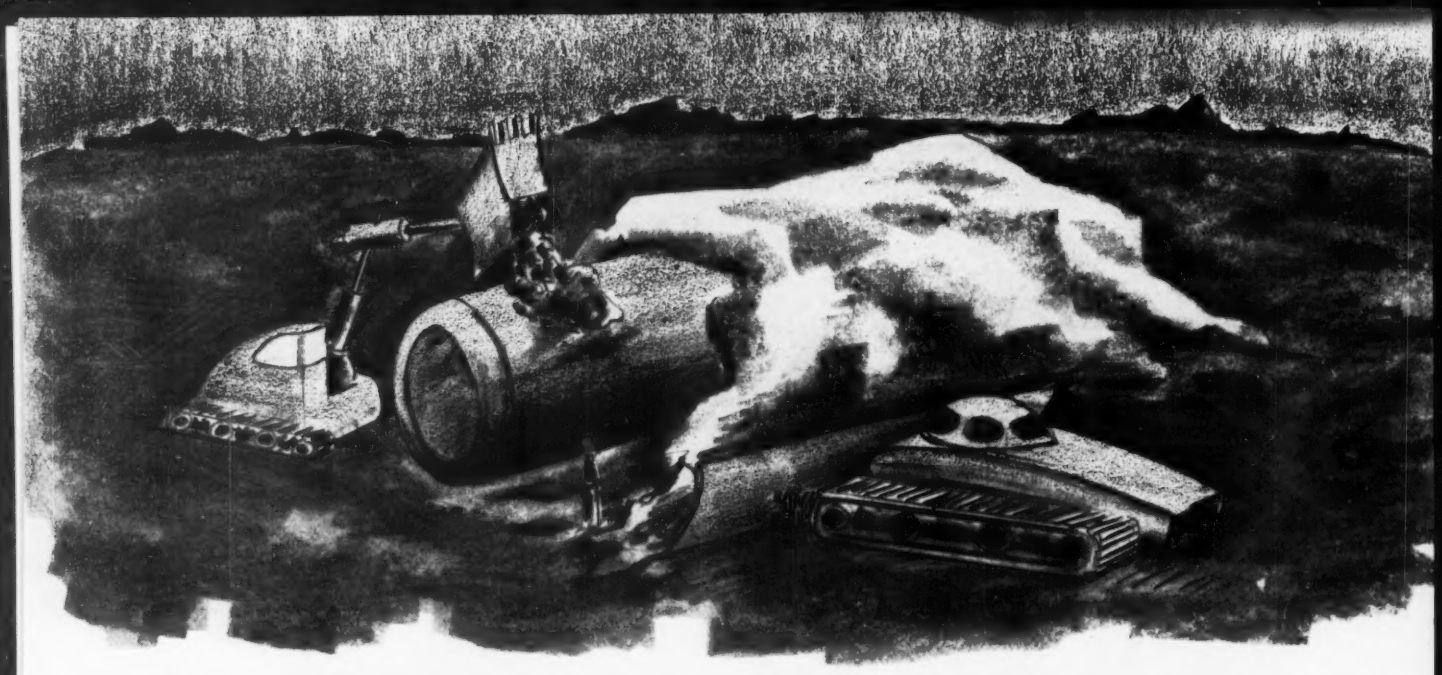
	EARTH	MOON
Period of Revolution	Around sun — 365 days On own axis — 24 hours	Around earth — 27.3 days On own axis — 27.3 days*
Distance from Earth		238,800 miles
Diameter	7930 miles	2160 miles
Surface Area	196,950,000 sq. miles	14,650,000 sq. miles. About equal to North and South America together
Acceleration of Gravity at Surface	32.2 ft per sec per sec	5.3 ft per sec per sec
Comparative Weights	100 lb	16.5 lb
Atmosphere	About 7 miles, giving 14.7 psi pressure	Barest trace — no pressure
Physical Nature	Mountains and plains with vegetation; land and water	Rugged and barren with slag cover; no water
Temperature Range — Surface	–50F to 140F	–240F to 275F

**Two weeks of day, then two weeks of night*

During the moon's two-week long period of daylight, the sky is black (no atmosphere to scatter light), the sun is about the same size as seen from the earth, and away from its blinding light, the stars are visible. On the side facing us, the earth is visible day and night, and it goes through phases, similar to the phases of the moon visible from earth. The earth in a "full earth" phase appears as a bright disc about four feet in diameter. However, the earth does not rise or set but occupies a fixed position in the sky. From the back of the moon, the earth is never visible.

Unlike the earth, where meteors are intercepted and destroyed by friction in the atmosphere, the moon is fully exposed to meteoric attacks. According to one theory, the craters on the moon and its peppered surface are the result of the impact of meteors, but these surface features may have accumulated through billions of years, since there is no erosion to obliterate them. Very little is known





about seismic activity on the moon, and intensity and frequency for various regions will have to be studied. Some indication of volcanic action has been reported.

Design of Structures

For structures to be erected on the moon, materials and prefabricated parts will have to be selected and designed not only for the environment but also for most efficient delivery. The cost of delivering a pound of material depends on the rocket thrust available, and when transportation to the moon becomes practical, the rocket thrust should have increased sufficiently to permit payload delivery at a cost of $2000-$3000 per pound. At that price, the cost of transportation would still be the largest cost factor. Materials and fabrication cost will be secondary. Therefore, it will pay to spend a great deal of engineering effort to reduce weight to a minimum and to bring size and shape to an optimum for transport. Very light structural elements, for example, will have to be designed for compact stacking and packing. Ease of assembly and erection, first with simple tools and later with special construction equipment, will be necessary. And there should be maximum use of local materials to supplement those shipped from the earth.

The early structures to be constructed on the moon will likely be of three types:

¶ Enclosures for human habitation. The exteriors will be exposed to the moon's environment, while conditions inside will be much like those on earth. Reduced gravity will affect the entire structure.

¶ Structures within the housing enclosures. Design of these frames, racks, and supports will be governed by conditions similar to those on earth, except for reduced gravity.

¶ Outside structures. The design conditions for bridges, towers, rail systems, and other such structures will differ greatly from those on earth. Particular attention must be given to reduced gravity, temperature variation, and lateral loading.

Housing Structures

The first consideration for housing structures on the moon must be the provision of a necessary atmosphere of air or some other suitable mixture of oxygen and inert gases. Medical studies will have to approve the gases and mixtures selected. Some good work along this line now is being done by way of submarine experiments. There are indications that an oxygen-enriched atmosphere with a pressure of 8 to 10 psi will be adequate.

The need for positive internal pressure naturally suggests a sphere as the most economical shape as far as the skin material is concerned. However, a number of other considerations may lead to the choice of a long cylinder with its axis horizontal. The cylinder permits better use of the internal space, and the radius of a long cylinder can be made less than the radius of the sphere of equal volume. This will permit the use of erection equipment with a shorter reach. The circular elements of the cylinder are more easily fitted, with reduced warpage under temperature extremes. The cylinder also can be easily divided by bulkheads into various compartments for safety.

If the ground surface proves to be rough and rocky, the cylindrical enclosure might be supported on adjustable legs. If there is sufficient bedding material of dust or slag, the cylinder could be set in an excavated cradle. The structure could be shipped in the form of prefabricated slices or rings, each containing its own partitioning, plumbing,

duct work, and equipment components. Construction would consist of fitting the rings and sealing the joints.

Thin metal plate would be suitable for the skin. A number of light weight, high strength metals are now being developed and could be adopted. Painting the outside surface with a highly reflective white paint would help reflect the heat during the day. However, during the night, heat would have to be retained, so the inside of the skin should be reflective, too. In fact, the maintenance of the proper interior temperature will not be easy.

As an alternative to the metallic skin, consideration should be given to the use of impregnated fabric made airtight for 10 psi pressure. The entire skin could be rolled into a single package for shipment and inflated at the site. A number of stiffening ribs would be required.

In the selection of materials, emphasis should be on high strength and light weight. Corrosion resistance is not important, since there is no atmosphere. There is, however, the effect of vacuum to be considered. Some synthetics and plastics may evaporate or boil molecules off the surface, so that there is a gradual loss of material. In addition, meteoric dust will abrade the surfaces. The abrasion may not be structurally harmful, but it could destroy a reflective surface which would result in seriously overheating the interior.

In view of the danger of puncture by meteor pebbles, consideration should be given to covering the structure with a blanket of moon slag. If this material is of the consistency of our pumice or cinders, a cubic foot of which weighs 90 pounds on earth, it will weigh 15 pounds per cubic foot on the moon. A few feet of this material would be a very light load against the internal air pressure. It should also be a good insulating material, which could be advantageous.

Interior Construction

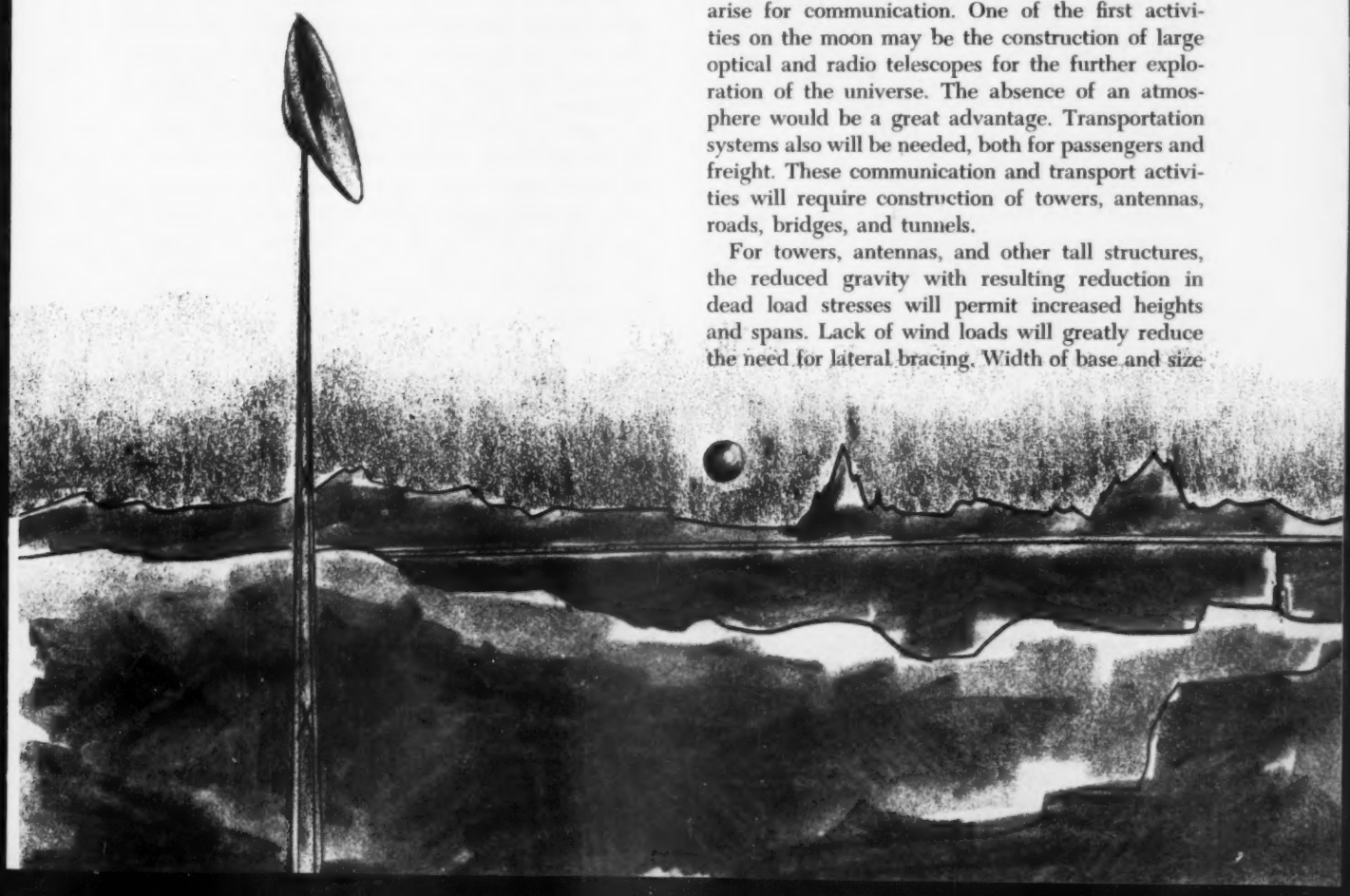
The housing enclosure should be subdivided into a number of compartments to provide living quarters, laboratories, shops, and store rooms. There must be equipment for air purification and circulation, including live plants for oxygen regeneration. Sanitary-chemical equipment will be necessary for recovery and re-use of water, and power generation of some sort will be needed – probably nuclear or solar in nature.

The conditions for design of the interior structures for support of these various loads will differ little from corresponding interior conditions on earth, except for reduced gravity and the need for compactness and economy in weight. Stiffened plates, sandwich and honeycomb panels, and perforated and latticed members are some of the forms being studied.

Bridges and Structures

Following the establishment of bases, the need will arise for communication. One of the first activities on the moon may be the construction of large optical and radio telescopes for the further exploration of the universe. The absence of an atmosphere would be a great advantage. Transportation systems also will be needed, both for passengers and freight. These communication and transport activities will require construction of towers, antennas, roads, bridges, and tunnels.

For towers, antennas, and other tall structures, the reduced gravity with resulting reduction in dead load stresses will permit increased heights and spans. Lack of wind loads will greatly reduce the need for lateral bracing. Width of base and size



of foundations can be less than on earth unless there are earthquakes of some sort. The proportions of these structures will be quite different from those we see here on earth.

For bridges, reduced gravity and absence of wind loads will reduce the required section moduli and areas of sections for main members and lateral bracing. Long span construction will be achieved easily. Aerodynamic instability will be no problem. However, vibrations will not be damped as rapidly as on earth. Thin plates and light shapes will be more advantageously used, and stability rather than stress should govern the design.

Use of concrete for piers, abutments, and foundations will not be possible unless some type of waterless cement is invented, for it is not likely that it would be practical to carry water for mixing concrete. Piles make more sense.

Temperature Stresses

A plate of dark color, such as painted or oxydized metal, lying on the surface of the moon and receiving the sun's rays at right angles, may be considered as an approximation to an ideal black surface. The plate will absorb the heat from the sun and will in its turn radiate heat into space. Equilibrium is reached when the rate of emission is equal to the rate of absorption. Fairly simple calculations indicate that this condition is reached on the surface of the moon at a temperature of 246 F, which is, then, the theoretical maximum temperature of the moon's surface when the sun is in zenith. This theoretical value checks with thermoelectric measurements made with high-powered telescopes. If the heated plate is located at some distance above the surface of the moon, there will be radiation from both the top and bottom, and then equilibrium would be established at the much lower temperature of 135 F.

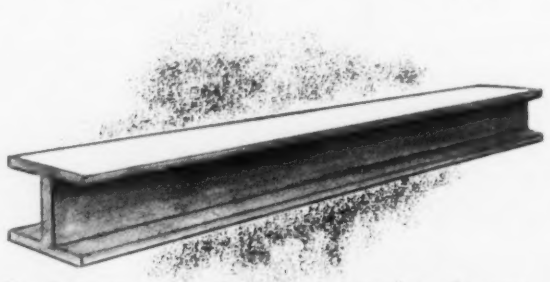
The type of problem engendered by this temperature condition is illustrated in the examination of a section of a 24- x 9-in. steel beam with the sun's rays at right angles to the upper flange and the rest of the surfaces in shade. Heat from the upper flange is transmitted to the lower flange by conduction through the web, and all surfaces of the beam radiate heat into space in proportion to their areas and the fourth powers of their absolute temperatures. If we assume that the temperature at the web varies uniformly from top to bottom, we can, by the application of elementary algebra, determine that the temperature of the top flange is —17 F, even in the sun, while the bottom web is a cool —103 F. The beam turns out to be cold instead of hot because such a high proportion of its surface is shielded from the rays of the sun, and on the moon it is –250 F in the shade.

Temperature difference between the flanges is 86 F. Therefore, if the beam is free it will tend to curve, but it will have no stress. If the ends of the beam are fixed to prevent rotation, the bending stresses will be about 8000 psi, with compression in the upper flange and tension in the lower. If the ends of the beam are further fixed to prevent direct elongation or contraction, there will also be a direct stress. The magnitude of the direct stress will be a function of the difference between the average temperature of the beam (—60 F) and the temperature at which the erection of the beam took place. Thus, if the beam was erected at a night temperature of —250 F, the direct stress will be about 37,000 psi compression. Combining this with the bending stress of 8000 psi, we get a maximum stress of 45,000 psi.

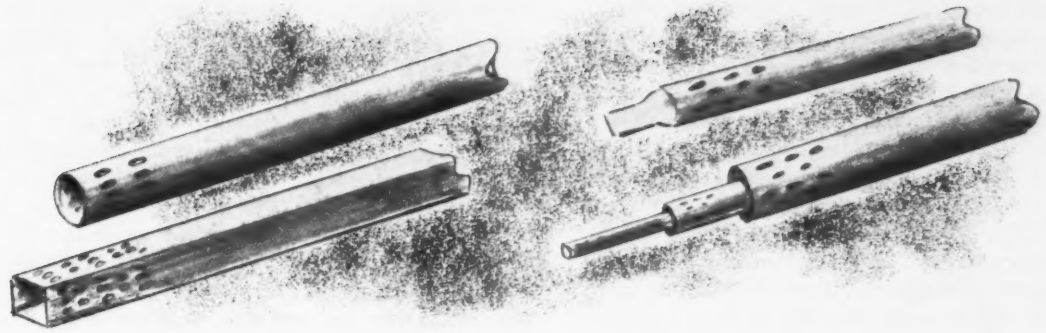
For the same beam, with the sun at right angles to the web, the temperature of the entire section will be a nearly uniform 57 F. The direct stress is increased to nearly 60,000 psi, but the bending stresses are small. For an open web member, such as a truss or a latticed column, there is little transfer of heat by conduction through the web, and the temperature difference between the exposed side and shaded side of the member is great — on the order of 200 F.

If instead of a single member we consider a framed structure, a bridge, or a tower, the analysis will not only have to include the effects of uneven temperature in each member, but the effects of members on each other. With varying positions of the sun, there will be various combinations of light and shadow on each member and different shadows cast by one member on another. It must be remembered that on the moon shadows linger; they move 28 times slower than on earth. The hot and cold members will produce extremely complex conditions which can be best analyzed with an electronic computer.

The severity of thermal extremes can be reduced by selective painting. Where cooler conditions are desired, surfaces exposed to the sun can be painted a reflective white to reduce heat absorption, and surfaces permanently in shade can be equipped



On the moon, a simple I-beam exposed to the rays of the sun will require a detailed structural analysis.



These perforated structural members may be representative of the shapes that will be used in lunar construction.

with fins so that heat release surface is increased. Where equilibrium is reached at too cold a temperature, the treatment can be reversed, arranging for more and darker surfaces exposed to the sun.

The problem of temperature stresses may be solved by shielding the structure from the sun's rays. Opaque curtains or jalousies of lightweight fabric or plastic can be hung around and above the structure. Except for some heat filtering through these shades and some heat reflected from the moon's surface, the structure will not acquire much heat during the day, and its temperature will remain about the same as at night, about –250 F. Erection of structures would be scheduled for accomplishment during the night. The members and sub-assemblies would be fabricated to dimensions for night temperature. After sunset, the members would quickly cool off to a uniform temperature and permit a good fit. When the structure was completed and the curtains hung, its temperature would remain practically constant at all times.

Working conditions in space suits at night should be better than in the daytime, since only a well heated suit would be required. The space suit for daytime, on the other hand, would be encumbered by devices and controls to shut off heat on the sunny side and add heat on the shady side, while the wearer is moving about.

Earth-light at night would be good (about 16 times greater than in our moonlight on earth), but artificial lights or reflectors will be required in deep shadows or during the weak phases. On the back of the moon, nights are pitch dark and artificial light essential.

Dynamic Loading and Impact

The dynamic effects of moving loads on bridges and structures are the result of vertical drop or fall of the load, such as would occur at bumps or rail joints, or the result of acceleration and deceleration. The kinetic energy of a falling body on the moon is one-sixth of what it would be on earth, thus, it is diminished in the same proportion as weight. Therefore, impact resulting from a free fall can be expressed as a percentage of the live load, as is commonly done here on earth. For impact brought about by forces other than gravity, the moving mass and its velocity must be considered, rather than the weight, and these changes should not be expressed as a percentage of the live load. Nongravity dynamic loadings are not scaled down on the moon and are, therefore, relatively more important than on earth. For example, in design of supports for machinery, we are accustomed to provide rigidity and weight in the support in some relation to the weight of the moving parts of the machine. Often the ratio is established by rule of thumb. Any such rule must be modified for conditions of reduced gravity, because of the unchanged dynamics.

Structural Members and Details

The requirements of light weight and compactness, and the severe effects of temperature extremes, suggest that study be given to special structural materials and shapes. The metal selected should have high strength, light weight, high ductility, and low coefficient of expansion.

Thin-walled tubular metal shapes seem to have many advantages:

¶ Several sizes can be fitted, one inside the other, in compact parcels for shipment.

¶ Circular and rectangular shapes make highly efficient columns and tension members, especially when designed for stability rather than stress.

¶ Rectangular shapes make good beams and girders.

¶ Perforations can be concentrated at the ends of long beams where less metal section is needed, and thus reduce weight to a minimum.

¶ Nonperforated circular tube will receive solar heat on its projected area and emit heat from its full surface — a ratio of 1:3.14. This is much more

favorable than with an H or I beam, and will result in less bending stress and less distortion.

¶ Staggered perforations would permit some sunshine to reach inside the tube and would result in nearly equalized temperature throughout.

¶ Ends of the tubes can be flattened easily in the field, to form connections for welding or bolting.

¶ Wall thickness of the tubes can be reduced even beyond the limits of stability, and the necessary stability provided in the field by filling with local slag material if found suitable. Strong columns could be formed with very thin shells.

¶ Thin flat pre-cut plates could be rolled in the field into circular pipe (stove pipe fashion).

¶ Thin metal need not be galvanized or coated in any way except perhaps for control of heat.

¶ Thin metal is suitable for resistance welding in the shop and in the field.

Factors of Safety in Design

Here on earth we must design structures to have a margin of strength and stability well beyond the stresses they are intended to sustain in service. We apply coefficients of safety to compensate for:

¶ Inaccuracies in theory or in design computations.

¶ Defects in the materials not discovered by tests or inspection.

¶ Deterioration of the structure with time.

¶ Accidental overload.

¶ Increasing the factor of safety if failure would result in a disaster involving many persons.

Applying this thinking to lunar conditions, more accurate analysis (avoiding short cuts and approximations) will be justified by the urgency for minimizing weight and bulk. With this careful design work, mistakes should be rare. Furthermore, rigorous inspection and testing will reduce the probability of material defects. Rusting, rotting, and similar physical deterioration is not serious on the dry surface of the moon. Structures will be subject to obsolescence rather than deterioration, though it is conceivable that frequent and extreme temperature change could be injurious to some material. Accidental overload should be unlikely with well regulated and planned activities by selected personnel. On the other hand, with regard to the housing structures, even a small or local failure could lead to serious disaster.

Highways and Railroads

Some sort of transportation system will be essential. There will be freight and passenger traffic, and special vehicles will have to be designed. Electric-powered trains may be found most suitable for rapid passenger traffic, while heavy freight may be more conveniently moved by cars or flats pulled by self-powered tractors. For short distances, drivers and passengers can use space suits and ride in open vehicles or platforms. For long distance travel, pressurized cabins will have to be used, with air and temperature control. Numerous problems will have to solved. We do not know the effect of severe temperature changes on certain machinery, nor are we thoroughly familiar with behavior of lubricants in a vacuum.

Reduced gravity will favor the use of steeper grades for highways and railroads, with resulting economy in earthwork. There will be no drainage problem, and no need for shaping of roadway section with crown and ditches. There will be no drains and no culverts. Without waterways, bridges will be needed only for crossings over depressions and chasms.

Curves will present a special problem. For the same velocity and radius of curve, the required super-elevation would have to be six times that on earth, since the weight of the vehicle is reduced six times while the centrifugal force is unchanged. A proper super-elevation on the moon might be too steep for conventional vehicles, and the best solution might simply be the reduction of design speed for curves.

Concrete pavement will not be practical until some suitable waterless cement or binder is developed. Asphalt may not stand up to the temperatures and the vacuum. Dirt roads, however, are likely to be more satisfactory than on earth. They will never be muddy, and there will be no washouts. Clouds of dust will not hang in the air after passing vehicles. Dust particles kicked up by the wheels will drop as though they were pebbles.

Driving in the daytime will not always be comfortable. When the sun is low in the sky there will be dense shadows cast on the road by adjacent hills, ramparts, or boulders. There sometimes will be double shadows, one set from the light of the sun and one set from the light from the earth. Open cuts, with black sky above, will be as dark as tunnels. Spots on the road where visibility is bad will have to be lit up by reflectors. Nighttime driving, with headlights, will be simpler.

Construction of roads, including earthwork and tunneling, will be in some respects easier on the dry moon, but the design of excavation machines will have to be changed. The excavated material will be lighter but its shearing strength is likely to be of the same order as on earth.

Electric tools will most likely be used in construction, for pneumatic power will not be practicable. Hand tools will have to be redesigned for mass and weight. Space suits will mean short work shifts, but for many tasks, working against reduced gravity, a man will find himself suddenly a Hercules — if only for a project on the moon. ▲▲

What the Bureau Is Doing Abroad

The Commissioner of the Bureau of Public Roads explains the foreign operation of his organization

ELLIS L. ARMSTRONG
Commissioner, Bureau of Public Roads
U. S. Department of Commerce

HELPING OTHER COUNTRIES to help themselves in providing highways is the prime objective of the Bureau of Public Roads in its foreign activities. Often this has involved giving a hand in setting up new highway departments or in modernizing and improving those in operation. The objective has not only been to provide new roads, but more important, to provide training and guidance to produce an organization fully capable of building and maintaining them.

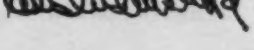
With full recognition that the living standard and political stability of any country or area depends largely on the development of a good road communication and transport system, and that this development is a prime prerequisite to social and economic development, the Bureau has been happy and anxious to asssist with this work. This type of service is not new to us, for the Bureau was created in 1893 as the Office of Road Inquiry, with the specific assignment of determining the best methods of road management and road making and of disseminating this information. One of the Bureau's first accomplishments was the construction of object-lesson roads to demonstrate what could be done in roadbuilding and how good roads effect the surrounding area.

In the development of America's 3,500,000-mile highway system, and in the present accelerated program to bring the system up to date, the Bureau has occupied a key position. As the representative of the Federal Government in the Federal-State partnership development of the 850,000-mile Federal-aid system, the Bureau has an intimate working relationship with all 50 State highway departments in resolving the many problems connected with highway planning, construction, operation, and maintenance. The Bureau is the principal ex-

I have sketched in this article the policy of the Bureau of Public Roads in providing highway development assistance to foreign countries. The article describes the projects the Bureau has completed and those on which we are now engaged. I am most anxious to put this information before consulting engineers, for I know that the Bureau has been criticized at times for apparently competing in foreign countries with engineers in private practice.

Our assigned task, generally, has been to help foreign nations set up their own highway departments capable of developing and maintaining suitable highway systems. We have retained consulting engineers to help us on some projects, and the foreign highway departments that we have helped to train have used consulting engineers after our program was completed. When we have done work through our own engineers that could possibly have been placed with consultants, it was primarily because the jobs to be done demanded actual design demonstrations as part of our training program.

I am confident that the work the Bureau is doing in foreign nations, along with our program of intensive training of foreign engineers in this country, will result in greatly enlarged highway systems directed by well-trained staffs of local officials who will be thoroughly familiar with U. S. design methods and U. S. materials. This should result in increased design activity for U. S. consulting engineers.



ponent, leader, and collector of research in the highway field, and much of our effort is in this direction. This includes the fields of physical research, traffic operations, broad transportation system planning, land use, highway and land administration, highway economics, and all related studies. As the highway design and construction agent for the Federal Government, the direct operations of the Bureau have covered the whole range of physical and economic problems faced by the entire country.

The breadth and depth of the Bureau's highway experience has made it a logical agency to assist other countries in getting their highway programs into operation. The close association with the 50 State highway departments makes its help and assistance in establishing highway organizations particularly effective.

The Bureau's activities outside the United States started in 1930, with studies launched that year, in cooperation with several Central American republics, to locate an Inter-American Highway to connect North and South America. This 3,142-mile highway project, because of its overall importance to the Americas, has been a joint undertaking by the United States and the countries in which it is located. It is now nearing completion. Financial as well as engineering assistance has been provided by the United States on the 1,555 miles in the six Central American republics. The section in Mexico has been engineered and financed wholly by that country and is completed.

In other countries, efforts have been centered on assistance in the establishment of highway departments and on the training of staffs. The training has been given in those countries and in the U. S. Many of these activities have been undertaken at the request of, and with funds provided by, other American and international agencies, including the International Cooperation Administration, the Export-Import Bank, the International Bank for Reconstruction and Development, and the Development Loan Fund.

Design and Construction Avoided

The Bureau generally avoids doing direct design and construction supervision work. However, in carrying out the chief function, guidance and instruction, it is sometimes better to build an object-lesson road than to explain what should be done. When there is no local highway organization, it may be necessary to do some surveying and design work to get started. And sometimes the prestige that goes with an arm of the United States Government is necessary to get a program under way. These efforts assist the countries in setting up their own organizations to carry on the work.

Bureau of Public Roads equipment specialist supervises tractor tread repair job in the Phillippines.

Private engineering consultants have been directly retained by the Bureau in various areas, including Turkey, Liberia, Ethiopia, and Central America. The Bureau has assisted a number of countries in selecting and retaining consulting firms for engineering services.

The Bureau now has 160 people, about half of whom are engineers, on assignment in 17 foreign countries. In addition, a number of short advisory assignments of a few men each are continuing.

Training of Foreign Engineers

The Bureau's training work in other countries generally has been associated with specific projects. Since the end of the war the Bureau has worked closely with the International Cooperation Administration, the State Department, the International Road Federation, private foundations, and the United Nations in providing training in the United States for various highway officials, contractors, and others connected with the highway industry from other countries. These training missions have varied from a few weeks to two years and have covered all aspects of highway problems. Last year, even though the training was less than in some previous years, 500 man-months of training for 145 participants from 45 different countries were provided by the Bureau in cooperation with the State highway departments. Informal training also was given to 130 additional visitors.

In the formal training a program is tailored to individual interests within a broad pattern. Generally, upon arrival in this country, a training group spends some time in the Washington office for a series of briefing sessions. These cover the overall highway systems of the United States; general

problems of construction and maintenance; the research program under way; the variations in climatic and topogaphic conditions across the country; effects of national, State, and local legislation on highways; problems of financing and administering highways; and other broad phases of our operations.

These sessions are conducted on a discussion rather than a lecture basis. Material, prepared by the Bureau, is supplied in advance to the officials in each group so that the discussions will center as much as possible on pertinent matters.

After the briefing sessions, a participant may go to our divisions in Washington, one of our field offices, or to our laboratories, depending upon his particular interest. It might be to a State highway department, to a tour of construction projects, to equipment manufacturing plants or to a number of other places where we think he may get the information or experience of most value to him.

Over 1200 participants from 75 countries have "graduated" from this program, and the Bureau's certificate of training appears all over the world.

Inter-American Highway

Plans to link the Americas by land have long been considered, including a Pan American railroad proposed in Congress, in 1884. The reconnaissance survey authorized in 1930 was completed and a report, prepared by the Bureau of Public Roads, titled "Proposed Inter-American Highway," covering the section between Laredo, Texas, and Panama City, was published by Congress in 1934. This study was followed by an initial construction appropriation of $1 million in 1934, which was used primarily to demonstrate possibilities of modern road and bridge construction on sections of the highway which could be put into service immediately. The work was done under a partnership arrangement, with the Bureau providing supervision, technical assistance, and materials such as steel. The Central American countries provided local materials and labor.

Maintenance crews in Liberia get Bureau training in the care of modern U. S. heavy duty road equipment.

In 1941 a further appropriation of $20 million was made for cooperation with the countries south of Mexico to and including Panama. Each country contributed one-third of the cost of the highway within its borders, two-thirds being provided by the United States. This fund-matching arrangement has been continued since.

Our Government has now allotted $138,703,000 to assist the Central American countries in building their part of the highway under the supervision of the Bureau of Public Roads. The six countries – Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama – have committed $82 million of their own funds.

To make the 1555-mile route passable, a contract for construction of 39 bridges by spring of 1962 was recently let in Costa Rica. At that time the $220 million route will be complete, with 1,200 miles of pavement, 355 miles of gravel surfacing, and all bridges and other drainage structures in place.

The Bureau's activities on the Inter-American highway have involved direct design and construction supervision as well as training and review and approval of the Central American countries' operations. All of the countries now have highway departments carrying on the Inter-American highway work within their boundaries, with the Bureau's review and approval at each step where U. S. funds are involved. This insures full value and adherence to standards and agreed-upon procedures.

In addition to the Inter-American Highway, the Bureau has provided assistance to Guatemala in cooperation with ICA in developing the Pacific Highway from the Mexican border to the border of El Salvador, and the Atlantic Highway from Guatemala City to Puerto Barrios. Consulting engineers were used on portions of these highways (see CONSULTING ENGINEER, September 1960).

In Nicaragua, technical assistance has been provided in planning and construction of the National Highway System, financed in part by a loan from the World Bank. The Bureau also represents the U. S. Government in the construction of the Rama Road, extending 158 miles from San Benito on the Inter-American Highway to Rama.

The Bureau at present has a total of 35 engineers and 16 supporting personnel assigned to the Inter-American highway region and division offices.

Activities in the Philippines

The Bureau was directed by the Congress under the Rehabilitation Act of 1946 to undertake a $40 million program of highway and bridge rehabili-

tation of war damage in the Philippines. This extended from late 1947 to 1951. Under a program to assist the International Cooperation Administration, the Bureau then continued as highway consultant on an expanded highway program. New legislation was proposed, accepted by the Philippine Government, and passed into law, thereby setting up a Philippine Bureau of Public Highways. Highway users' revenues under the new laws accrued directly to a special highway fund.

With the Bureau's help and advice, a modern highway department was established competent to perform all necessary operations in conducting an annual highway program of some $50 million a year. Extensive on-the-job training has been provided since 1947, and today the Philippine Bureau of Public Highways can hold its own with most of the State highway departments in the United States. Bureau personnel has been reduced from a total of approximately 50 in 1949 to 5 at present, with a complete withdrawal scheduled for next year.

The experience developed in these operations has set the pattern for similar developments in Turkey, Ethiopia, Liberia, Jordan, Iran, Lebanon, Nepal, and the Sudan.

Activities in Turkey

In 1948 the Bureau was requested to undertake a program in Turkey to aid and assist the Turkish Government in setting up a complete highway organization and to conduct an extended program of highway construction and maintenance. Some $40 million worth of equipment was purchased by the Bureau under regular United States Government procurement practices. Shops were established in 12 divisions along with three major warehouses for spare parts and materials. Turkish nationals, including engineers, administrators, planners, and maintenance forces, were trained on the job for all phases of operation. Since 1947, when the first U. S. specialists arrived, the mileage of all-weather roads and the number of motor vehicles have more than quadrupled. The interior of Turkey has been opened up to modern commerce.

Turkey today has the most modern highway organization in the Near East. It is comparable to many of the highway departments in the States. It now provides technical assistance to other Near East countries and sets up seminars for training. Bureau personnel was reduced from a maximum of approximately 50 to none in 1959, when the program was completed. A 100 percent Turkish cadre of highway personnel is now operating an annual program of $80 million a year.

At present the Bureau is providing special advice by an electronic computer specialist and an accountant. Advisors are to be provided for a forest highway program being developed with funds made available from the Export-Import Bank.

Activities in Ethiopia

The Bureau started operations in Ethiopia in 1950, under a World Bank loan. As Ethiopia did not have a highway department or organization capable of handling a highway program, the Bureau was authorized by special Imperial Decree to organize and operate an Imperial Highway Authority. This was done using Ethiopians to the greatest extent possible but with the addition of some trained personnel from other nearby countries. While carrying on the actual operation of the highway program, an extensive training program was conducted to enable Ethiopians to eventually replace the Bureau in all phases of the operation. The success of this training program is indicated by the fact that the number of Bureau employees, totalling 46 in 1952 has already been reduced to 12.

A well organized highway organization, adequate in all phases of planning, designing, construction, and maintenance has been established. Ethiopian employees now in the Highway Authority, including all categories, total nearly 5,000.

Activities in Pakistan

At the request of the Government of Pakistan, the Bureau (through ICA) made a survey of highway requirements and conditions in East Pakistan, in 1952. In 1955 three projects were initiated for the purpose of establishing a highway organization adequate to handle the highway requirements of Pakistan and demonstrate, with limited facilities, modern methods and practices in highway design, construction, maintenance, and traffic use.

Activities in Liberia

Under a program, financed jointly by foreign aid sources and a highway loan from the Export-Import Bank, and at the request of ICA, the Bureau has been aiding Liberia with their highways since 1952.

Employing as many Liberians as posible, a highway division was set up in the Liberian Bureau of Public Works. Location, design, construction and maintenance work was undertaken. The number of trained Liberians was limited, so personnel from other countries have been used. A consulting engineering firm was retained for the design and construction supervision phase of a 180-mile project. It will be some yeares before Liberia has an adequate highway organization, but good progress is being made.

Activities in Lebanon

Public Roads has been providing technical assistance to the Government of Lebanon since July

Surveying crew in Liberia is getting on-the-job training under Bureau of Public Roads direction.

1958, in connection with ICA sponsored road improvement. The program includes repair and construction of a recently built major highway, new road construction, and organization and training of a consolidated highway department. Highway work was previously divided between five uncoordinated agencies. Advice on legislation was given to establish a highway department, which was passed and is now being implemented.

At present four Bureau engineers and one equipment specialist are on assignment in this country.

Activities in Nepal

Since April 1958 Public Roads, under agreement with ICA, has been providing assistance for Nepal highway improvement under a Tri Partite Agreement between India, Nepal, and the United States. Over 800 miles of roads are being improved and constructed. The principal objective of the Bureau's efforts has been to train a Nepalese staff in modern highway procedures. The present Bureau staff includes only seven men.

Activities in Jordan

In 1954, under agreement with the International Cooperation Administration, the Bureau began assistance to the Jordan Ministry of Public Works in organizing a highway department. Engineering advice and assistance has been provided in developing a highway system plan and in getting construction under way. Training in the use of modern construction and maintenance equipment has been an important part of the mission.

Construction has been completed on 200 miles of roads and the organization of a maintenance program is getting under way. The Bureau staff in Jordan consists of thirteen men.

Activities in Iran

The Public Roads mission to Iran was started in 1957, under the provisions of an agreement with the Iranian Ministry of Works and Communications. This mission was a prerequisite to the making of a loan by the Export-Import Bank.

The prime function has been to advise the Ministry on a highway maintenance program, the equipment for which was procured by the Bureau with an Export-Import Bank loan.

Activities in Sudan, Yemen, and Laos

Under agreement with the International Cooperation Administration, the Bureau of Public Roads established a mission in the Sudan in April 1958, to demonstrate modern techniques, methods, and equipment in the construction and maintenance of modern highways.

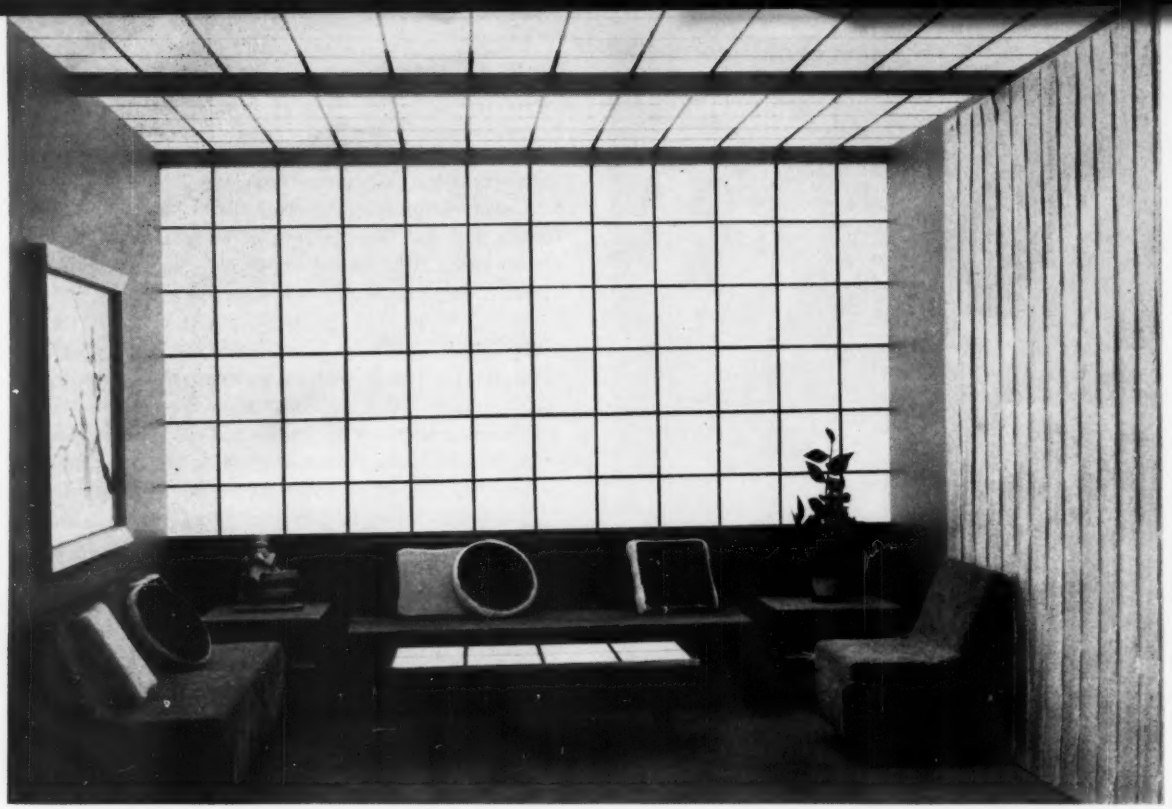
A mission to Yemen was recently organized under an agreement with the International Cooperation Administration to provide improvement of a portion of the road between Taiz and Saana. Only the most primitive of roads now exist and the road to be constructed will be on new alignment.

Public Roads is now establishing a highway mission in Laos to supervise the International Cooperation Administration road improvement program. Preliminary work necessary to complete funding and authorization has been finished. The Bureau will have direct charge of all highway work to be performed, working closely with Laos nationals.

Other Bureau Activities

It is expected that there will continue to be many overseas highway programs in which the necessary technical assistance can and should be provided by private consulting engineers. This is particularly true after highway departments are organized and functioning and the program calls for the survey, location, design, and construction supervision of a specific road or project, either to provide a needed highway or to demonstrate American techniques, methods, and modern mechanical equipment.

The Bureau will continue to assist foreign nations with the organization of highway departments and advise on needed laws and related matters. Once a highway department is efficiently staffed it will be able to make its own arrangements for the consultant services that it needs. ▲▲



Luminescent ceiling and wall panels will provide thinnest light source known when developed for general use.

The Chaos Above the Quiet Ceiling

C. J. DANOWITZ and L. G. PARKS, Ebasco Services, Inc.

CEILING SPACE is not rentable and there is a continuing effort on the part of owners and architects to reduce the ceiling to slab dimension in modern office buildings. In the construction of a multi-story building with a fixed height, reduction of the space between the hung ceiling and the floor above can result in additional floors – increasing rental area and creating a higher return on a fixed capital investment. This demand for reduced ceiling space can drastically affect the facilities required to meet building occupant needs.

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Functional Aspects of the Ceiling

To understand the problems involved it is necessary to consider the functional aspects of the ceiling. Primarily it serves as the overhead boundary of a space. It conceals the basic building structure as do wall and floor coverings. As a boundary it is, of course, visible to the occupant of the space and is therefore designed to be pleasing to the eye. But it also contributes to the cleanliness of the space, serves as a mounting platform for various service equipment, provides acoustical treatment, and in some cases acts as a fire stop. Below the ceiling everything is pleasant and orderly – above it is chaos.

In general, hung ceilings fall into five categories:

¶ Ceilings of acoustical tile, metal pans, or blankets. These ceilings generally provide cavity access.

¶ Plaster ceilings applied over metal lath. These ceilings provide no access to the cavity except through specially constructed removable panels.

¶ Perforated ceilings made from a variety of materials. They have the advantage of providing air flow from a cavity plenum, but are restricted to areas where cavities are fairly clear of obstructions to air passage.

¶ Electrical ceilings of the luminous or louvered types where the ceiling, in addition to its primary function, also serves as a lighting source. Ready access to the ceiling cavity is provided. However, the presence of lighting equipment may often seriously limit space.

¶ Special ceilings, usually associated with lighting effects, such as coves, coffers, and floating panels. Such ceilings afford limited access to the cavity, and often none at all.

The Battle for Ceiling Space

All of these ceilings are expected to provide acoustical treatment. This brings the acoustical engineer into the happy family of illuminating, electrical, mechanical, structural, and electronic engineers — all vying eagerly for space. Unfortunately, the component items of the various systems they design cannot be satisfactorily camouflaged to conform with the finished ceiling. Thus, they all must find a place above the hung ceiling in which to conceal them from view.

While the ceiling serves as a boundary for the concealment of various mechanical and electrical piping and ductwork, it must also provide access to this equipment. With a plaster ceiling, access doors are necessarily kept small, in the form of handholes. Large man-size access doors, while desirable, usually are not permitted. On the other hand, a hung ceiling of the exposed or concealed spline type provides flexibility since access can be achieved by the removal of a ceiling tile. Normal access is available for inspection or minor service problems, and if major modifications are necessary, it is possible to remove all the tiles without affecting the ceiling construction. Where frequent changes may occur, large savings can result.

Electrical distribution systems, communications, music and public address, alarm, security, fire detection, and television systems are normally run in conduit or cable. They may be exceedingly complicated, but do not usually require a great deal of space. The wiring systems employed are small in vertical dimension and may be snaked through congested areas quite handily. They also have the advantage of normally requiring access only at out-

A "busy" ceiling, of acoustical tile, containing the air diffusers and the return grilles, speakers, and lights.

Simplicity of design carried out in a "clean" ceiling, by using combination luminaire-air diffusers in plaster.

A metal pan ceiling, using a round air diffuser and a rectangular luminaire with a formed plastic lens.

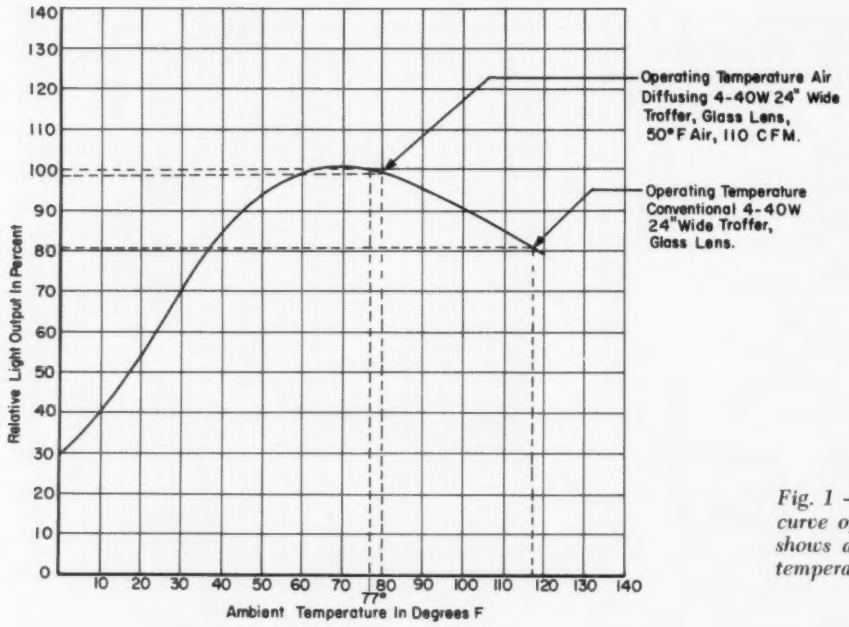


Fig. 1 — Temperature-light output curve of typical fluorescent lamp shows an increase in efficiency as temperature drops from 120 to 80.

lets in the plane of the ceiling. Underfloor electrical duct systems reduce the number of electrical facilities in the ceiling cavity, thus simplifying the space problem.

Sprinkler systems, gas, pneumatic tubes, water piping, and drain lines present more difficult problems since symmetry, bending radii, and pitch enter into their location. But of all the facilities installed in the ceiling cavity, those creating the greatest problems are air conditioning and lighting.

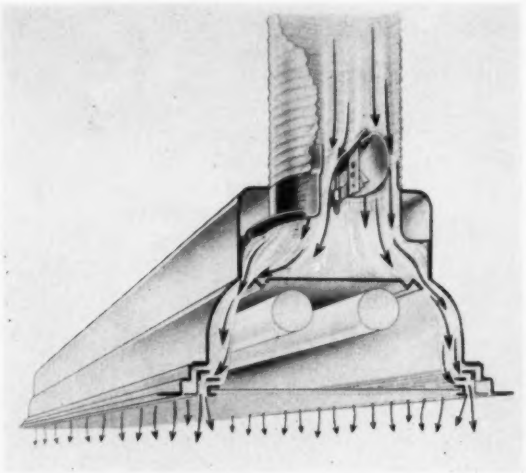
Lighting and Air Conditioning Requirements

Originally a lighting luminaire was the only item that was either located on or in the ceiling. With the development of air conditioning it was necessary to provide air distribution and, from the engineering viewpoint, the ceiling was the logical place. This presented a basic conflict, since fundamental engineering principles indicated that both the lighting luminaire and the air conditioning outlet should normally be located in the center of a space. The solution was generally based on which engineer assumed "squatter's rights" for the most desirable location.

With the gradual increase in lighting loads and the demand for lower temperatures, lighting luminaires could handle only a limited square footage and air conditioning diffusers had to grow larger to handle greater quantities of air. For offices on the perimeter of the building, air conditioning outlets or units under the window eliminated this problem, but for interior spaces, where the ceiling is still the best location for air distribution, the problem was aggravated. It is conceivable that a condition could occur where there would not be sufficient ceiling area for the lighting fixtures and air conditioning outlets. Some luminous ceiling applications have almost reached this point.

Light and Air Together

It has always been assumed that both lighting and air conditioning units cannot occupy the same space. This assumption has now been proven false, for several manufacturers are building equipment



Cutaway view of a combination luminaire-air diffuser showing air flow through a flexible hose connection.

which combines lighting luminaires and air diffusers. This produces a cleaner or less "busy" ceiling. Not only does it use the ceiling space more efficiently, but it also pays dividends from the illumination standpoint. In addition, better air distribution results because lower quantities of air are discharged from more outlets, reducing velocities necessary for "throw" and minimizing possible drafts.

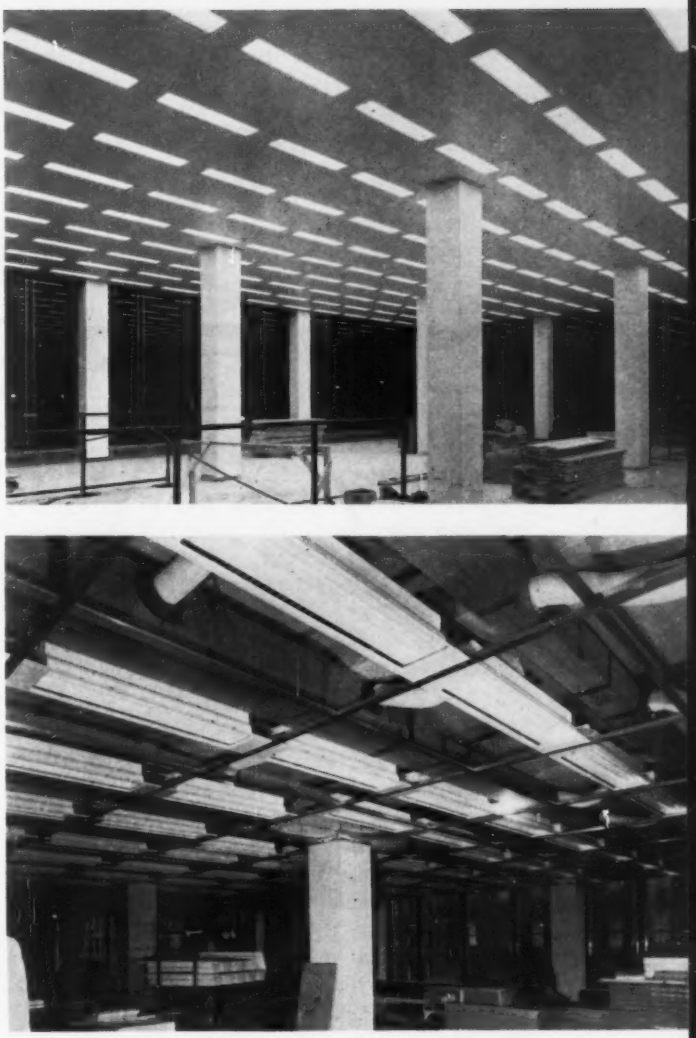
A unique characteristic of the fluorescent lamp is its temperature-light output curve, Fig. 1. Commercial luminaires operate in the higher temperature portion of the curve (around 117 F) and consequently produce only 80 percent of the light rating of the lamps. If 110 cfm of 50 degree air is passed through the luminaire the lamp temperature is reduced to 80 F and light output is increased 18 percent. This represents an additional illumination to the owner without an increase in capital investment. Actually, for a given level of illumination, this system will reduce capital investment by decreasing the number of luminaires. It also will reduce the quantity of air required for air conditioning, with a corresponding reduction in weight of sheet metal.

Air conditioning connections to the lighting luminaires can be flexible tubing, allowing the rigid main ducts to be placed in the cavity to minimize interference with other facilities. In addition, the combination luminaire and air conditioning outlet can be easily relocated. This is a great advantage since many offices undergo periodic changes in arrangement.

Lighting Trends

While the trend in light sources has been to higher and higher efficiencies, the same trend does not hold for the size of the sources. Unfortunately, fluorescent lamps of high efficiency have been of fairly low wattage, requiring many lamps to produce the same output formerly obtained from a single incandescent lamp. This characteristic is desirable, since source brightness is reduced and visual comfort increased. However, the large size of luminaires further increases crowding in the ceiling cavity. There is some compensation, since the increased efficiency of the fluorescent lamp reduces the air conditioning load for a given level of illumination.

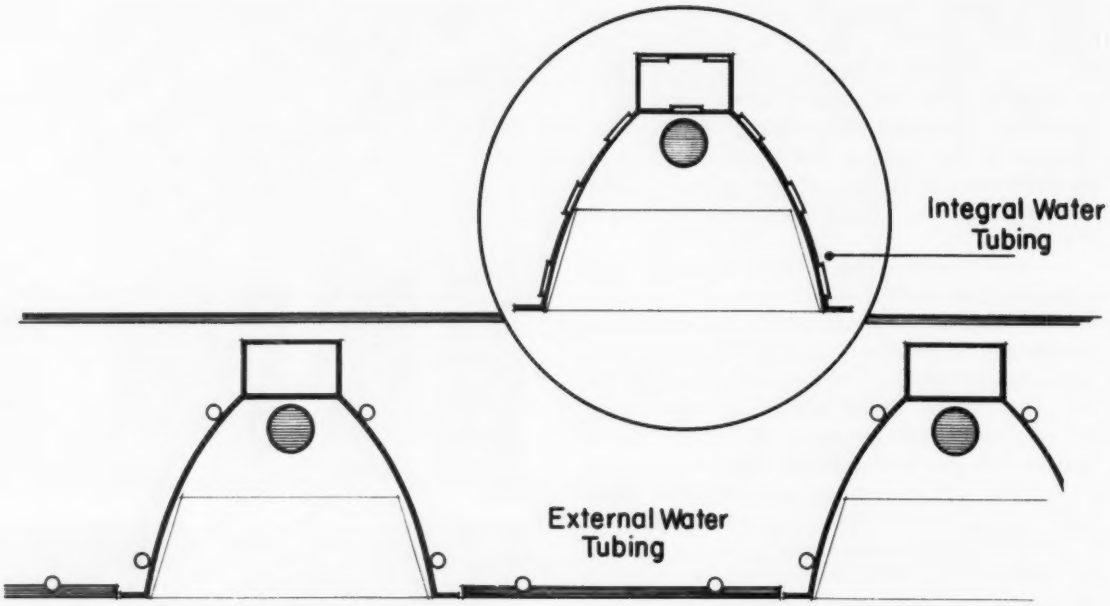
As techniques for employment of fluorescent lamps have improved, the over-all depth of luminaires has decreased. In 1947 many troffers were 10-in. deep, whereas today a 4½-in. depth is common. However, the problem has been intensified by the introduction of the electric ceiling. This ceiling, more commonly known as the louvered or luminous ceiling, has become very popular.



The uncluttered appearance of the finished ceiling, showing only the combination luminaire-air diffuser fixtures, effectively conceals the unattractive maze of wires, conduits, ducts, and structural members above it.

The lighting luminaire is constructed on the job and uses considerable ceiling cavity depth. In building peripheral areas where perimeter air conditioning systems (no duct work in ceiling) are employed, the electric ceiling is highly feasible. But in interior areas, where air conditioning is provided by duct work, such ceilings are not practical unless low ceiling heights are acceptable.

The louvered ceiling, with open construction, becomes a natural diffuser for low velocity conditioned air and has proven highly satisfactory for this purpose. It provides concealment for sprinkler systems without affecting their operation. But the luminous ceiling of solid construction presents air



Two types of water-cooled luminaires. The circulating water absorbs the heat dissipated by the luminaires.

conditioning problems of considerable magnitude. Several solutions are available, including slotted supporting rails, built-in diffusers, and perforated panels. In the case of certain low softening temperature plastics it also provides concealment of sprinkler systems, for the plastic softens and falls out before sprinkler operation begins.

The luminescent panel has several favorable characteristics. It is thin, lightweight, and may be formed to any shape. If it is developed to its potential high efficiency at a reasonable price, it will prove to be a valuable tool in building construction. It will require no cavity space, and its high efficiency would reduce air conditioning loads.

Recently, the formed fluorescent lamp panel has been experimentally introduced. The lamp is formed by placing two shaped pieces of glass together to form a lamp on the inside while maintaining a panel appearance on the outside. Dimensions have been reduced with a consequent reduction of cavity space requirement.

Mention should be made of high frequency operation of fluorescent lamps. Such operation shows a slight gain in lamp efficiency and a great reduction in ballast size. However, the smaller ballasts will have little effect upon cavity requirements since they will not reduce the over-all depth of the luminaire. This depth is dictated by lamp and control media characteristics and ballasts are presently mounted in what is otherwise unused space.

Current lighting recommendations for office buildings have reached a point where the lighting equipment and associated air conditioning duct work has considerable influence on the structural design of the building. Continuing trends toward higher levels of illumination, as well as increased use of decor lighting, indicate that this influence will continue to increase.

Removing Light Source Heat

Estimates based on present day practice indicate that in an office building lighted to a level of 100 footcandles, the lighting load ranges between 25 and 65 percent of the total air conditioning load. This percentage rises rapidly as footcandle levels are increased. Obviously, the size of air condition-

An uncluttered effect is achieved through the use of luminaire-air diffusers with an acoustical ceiling.

ing duct work increases proportionately to the increase in lighting load.

Several schemes have been tried in an effort to remove lighting source heat before it enters the occupied space. One method suitable for moderate loads consists of exhausting air through the lighting luminaires. Air movement through the luminaire will remove a considerable quantity of heat, thus preventing it from entering the occupied space and affecting comfort.

Another method that has been used in a few buildings is the utilization of water cooled lighting luminaires. The heat that is normally dissipated by the luminaire is absorbed by circulated water, reducing the load to be handled by the air conditioning system with corresponding reduction in the quantity of air circulated. This method does reduce the size of the air outlets, but it does not eliminate them entirely.

A third method that has been used is to provide a radiant ceiling where a large percentage of the load is absorbed by a cooled surface through which chilled water is circulated. With this method the requirements for air diffusion through ceiling type outlets is still necessary but, as in the case of the water cooled luminaires, the quantity of air needed is reduced.

Improved Ceiling Appearance

The problem of ceiling appearance currently is receiving more consideration. With as much thought being given to the arrangement of equipment on the ceiling as to the arrangement of equipment within the space above it, the location of the various equipment items has become an important consideration. In order to provide some symmetry, the air conditioning diffusers are located within an enclosed area in a direct relationship to the luminaires. This can be either between the rows of luminaires, in the same line as a row of luminaires, or any other arrangement to provide a symmetrical pattern. In general, this applies to supply outlets only, but the location of return outlets should also be considered in relation to a symmetrical pattern with the luminaires.

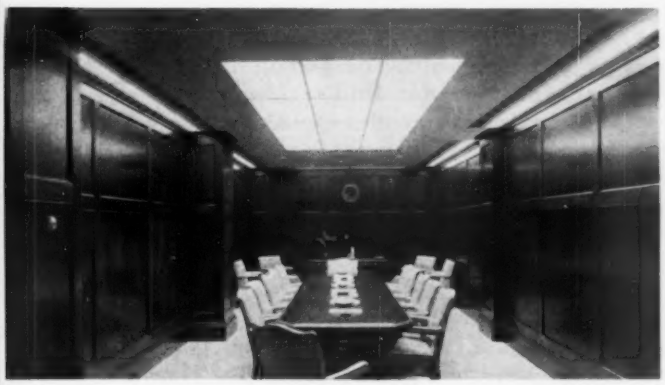
The original ceiling diffusers were of the circular type, but the hung ceiling with square or rectangular tiles and the use of square or rectangular luminaires has brought a trend toward the use of square or rectangular diffusers of a size to fit the ceiling tiles and minimize cutting of either the ceiling spline or tile. In addition, where unusual lighting is used, an elongated or linear type of air distribution unit can be used.

Another method of distribution uses a perforated panel, with air supplied to a section of perforated metal ceiling permitting air to diffuse into a room. This method has many advantages over the conventional ceiling diffuser, but has been widely used only in areas where large quantities of air must be suppled – primarily because of higher installation costs.

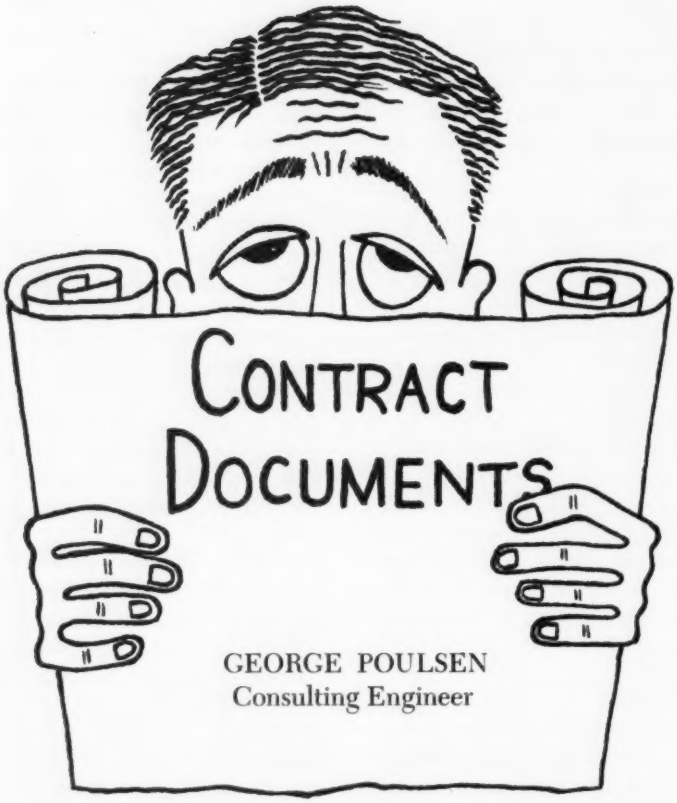
A ceiling plenum above the space to be cooled can also be used for air distribution. While this method has been available for a number of years, and has been tried by many engineers, it has only recently given real promise of success. A conventional ceiling tile with small cut slots is used. The diffusion of air within the space is controlled by small metal strips or valves which attempt to regulate the quantity of air that is supplied from each slot. It is desirable that the same quantity be supplied from each slot in order to get uniform air distribution. While resulting in the elimination of ceiling diffusers, this method does develop problems above the ceiling. Any penetrations of the walls forming a boundary of the plenum must be sealed tight in order to control the local air supply. This necessitates strict over-all supervision of all penetrations of the wall boundaries.

In addition to the other uses of the ceiling cavity, it is possible to install supply and exhaust fans and other similar mechanical equipment – where depth permits. Care must be taken to provide adequate vibration control so that occupants of the space below are not distrurbed by the operation of such equipment.

In spite of the difficulty of fitting all facilities into the ceiling cavity, engineers place emphasis on solutions rather than compromises. The air flow luminaire is a prime example of this approach. However, results of such developments are only transient since some other facility, new or yet to be developed, will demand additional space. The battle for space goes on with no truce in sight, but ceilings continue to improve. ▲▲



A combination of luminous panel, strip lighting, and downlighting, with linear air diffusers and returns.



GEORGE POULSEN
Consulting Engineer

THE SOLE FUNCTION of contract documents is communication. In the early stages of project design, they help the owner to find out whether the engineer understands exactly what he has in mind. If the owner is experienced in construction, he may be capable of making specific recommendations concerning the selection of materials, methods, and processes. But the owner who is without extensive experience will also want to review the engineer's contract documents before advertisement of the project. Even though he may not understand much technical detail, this review can insure that the project generally is compatible with his thinking. In addition, he will want to have his lawyer review the provisions of the legal and procedural documents, to assure himself that the agreement he plans to sign is legally satisfactory.

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Contract Documents During Bidding

Since competitive bidding is the rule for most engineering construction, contract documents are loaned to bidders for use in the preparation of their bids. Precise communication of ideas to the bidders is of great importance. Each bidder will carefully consider the fairness, consistency, and accuracy of the contract documents. Thus, the amount of his bid will reflect the quality of the contract specifications and drawings.

Frequently, the contractor is bewildered by differences in arrangement and content. Naturally, he prefers the familiar, so nationally or internationally accepted standard forms of contract documents which he has previously studied and which his contractors' association might also have studied and approved, are favored during the exacting work of preparing a bid.

If each set of plans has a different set of ground rules, the work of the contractor is increased. Since he must be paid for the time he expends in preparing bids as well as for the time he spends in the actual construction of a project, he will pass along to the owner any increase in cost resulting from complicated or nonstandard contract documents.

Furthermore, if he is afraid of the unfamiliar, his contingency factor will rise.

Use During Construction

The use of contract documents during bidding influences the cost of a project. Their use during construction influences the quality. Here again, communication is all-important. It is during construction that omissions, conflicts, duplications, overlappings, and lack of coordination penalize the project. These shortcomings can result in situations that are unfair to the contractor, and troublesome to the engineer. It is during construction that the relentless battle between truth and error must be fought. Dimensions must check, materials must fit, procedures must be sound – the written word must harmonize with the drawings.

All parts of the contract documents must have been fitly framed together so that the project can become the concept shown on the engineer's drawings and further described in his specifications.

Contract Document Interpretation

It is during construction that "the letter killeth, but the spirit giveth life." No contract documents ever prepared have adequately covered every situation met during the construction of a project. It is then that the guiding hand of an experienced and competent resident engineer gives a climate of fairness. He must be ready to permit changes in the contract documents that he is convinced will improve the project. He should be willing to acknowledge his own omissions.

On the other hand, he should firmly enforce the provisions of the contract documents that insist on performance by the contractor that measures up to the standards of workmanship, quality of materials, and performance detailed in the specifications and drawings. The resident engineer must assume that the contractor provided for a complete and satisfactory installation in his bid, since this is what the owner has agreed to purchase.

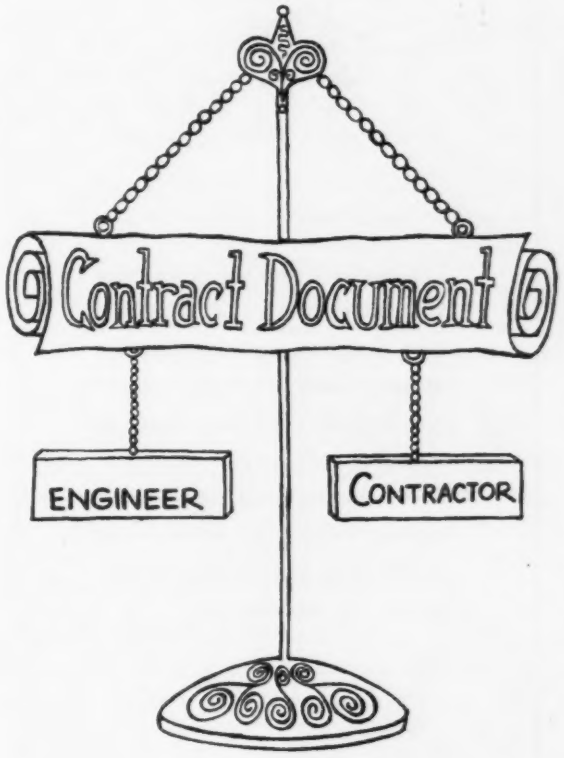
Standardization of Contract Documents

Standardization of contract documents has done much to eliminate areas of disagreement among owner, engineer, and contractor. Important work leading to the standardization of contract documents has been done by a number of organizations including the American Association of State Highway Officials, the American Society of Civil Engineers in cooperation with the Associated General Contractors of America, the American Public Works Association in cooperation with the Associated General Contractors of America, Consulting Engineers Council, and the International Federation of Consulting Engineers (FIDIC).

All of these organizations have had one primary goal in developing standard contract documents – the placing of every agreement in a setting familiar to the owner, the engineer, and the contractor.

The engineer has the responsibility of preparing contract documents on many projects, and he must outline the conditions under which each new agreement is to be performed. His work is made easier and his decisions will be more consistent, if the basic conduct of all jobs remains about the same. The engineer and contractor are, of course, the servants of the owner. They properly show a keen interest in procedures that will ultimately benefit the owner and, hence, upgrade the service which they seek to render.

Contract documents are legally binding upon the contractor and the owner. Current decisions of the courts frequently are based upon previous decisions in similar cases in other states. A national record of the courts' interpretations of the standard provisions of the contract documents would serve as a helpful guide to the parties to any construction agreement. Further, initial review by legal counsel of national stature is possible with nationally used contract documents. The proper legal review best can be obtained by using a single firm especially



An engineer with one of the large contracting firms says, "The first thing that our construction superintendent does on a new project is to request a meeting with the consulting engineer's representative, and then, with the resident engineer looking on, he tears the specifications in pieces and throws them in the wastebasket."

selected for the task, rather than by using numerous attorneys who are all working on a differently worded set of provisions.

Many other groups in addition to engineers, owners, and contractors are interested in the requirements of engineers' specifications. These include subcontractors, prospective clients of engineers, suppliers of materials, and manufacturers. These groups fully deserve advance notice of the standard provisions of contract documents, and every attempt should be made to insure that the provisions specifically affecting them are fair and equitable.

Organization of Contract Documents

All of the arguments in favor of standardization of contract documents also apply to the broad field of the organization of the documents themselves. The arrangement proposed by Consulting Engineers Council anticipates that every project be divided into five distinct parts:

Part 1. Legal and Procedural Documents and Bonds
Part 2. General Conditions of the Contract
Part 3. Special Conditions of the Contract
Part 4. Detailed Specification Requirements
Part 5. Drawings

Legal and Procedural Documents and Bonds

These include the documents familiar to all engineers:

1.1 Advertisement
1.2 Information for Bidders
1.3 Proposal
1.4 Agreement
1.5 Bid Bond
1.6 Performance Bond
1.7 Labor and Material Payment Bond

It is recommended that the advertisement (1.1) be included as one of the contract documents and bound with them so that the record of the project will be complete. Naturally, the advertisement will be sent to selected bidders, if bidding is invitational, or it will appear in the public press if bidding is to be public. The main items included in the advertisement are identification of the person receiving proposals, place and time of receipt of proposals, a brief description of the work, place and time of reading of proposals (if different from the place and time of receipt of proposals), procedure for obtaining contract documents, any pre-qualification requirements, the amount of any proposal guaranty, and the approximate cost of the work. From this information, any prospective bidder will know whether or not his firm is qualified to bid.

Information for bidders (1.2) extends the information given in the advertisement, which is general in nature. Much of the information included in the

advertisement might be repeated in the information for bidders, with certain added information to guide in the preparation of proposals. Subjects commonly treated in information for bidders include interpretation of documents, the issuing of addenda, proposal guaranty, performance bond, labor and material payment bond, and any wage scale requirements.

The proposal (1.3) is set up by the engineer to include all those special and distinctive features that the contractor must include in his proposal to fully complete the work. Included are the naming of the person to whom the proposal is made; a statement of the stipulated amount of the proposal; a brief description of the work to be done (including the name of the owner and the address of the work); a statement that the bidder is familiar with the contract documents and with local conditions where the work is to be performed; mention of the inclusion or transmittal of the proposal guaranty; a statement by the bidder that he will execute the agreement and furnish performance and labor and material payment bonds within the required time; acknowledgement of the receipt of any addenda; a listing of all applicable addenda; a statement of the contract time; and the signature, title, and business address of the bidder.

The agreement (1.4) includes identification of the owner, the contractor, and the engineer; a brief description of the project; a listing of all addenda; a statement of the contract time; a statement binding subcontractors to the argreement; a statement of the contract amount; a listing of the contract documents in the order of their precedence; a statement concerning the authority and responsibility of the engineer; any special provisions applicable to the project; and signatures, titles, and business addresses of owner and contractor.

Bond forms (1.5, 1.6, and 1.7) should have the approval of the national surety association representing the bonding company. The forms proposed by Consulting Engineers Council suit the project organization recommended by Consulting Engineers Council and have been prepared from the recommended forms of the Surety Association of America. It is noted that 100 percent performance bond and 50 percent labor and material payment bonds are prescribed.

Documents bring engineer, client, and contractor together

General Conditions of the Contract

Repeated use of the same set of standard forms of general conditions of the contract on projects designed by different engineers and on various projects designed by the same engineer, places the contractor on familiar ground on all these projects. His contractor's association will have studied the general conditions and will have prepared him to comply fully with its provisions.

To simplify the use of general conditions of the contract, Consulting Engineers Council has classified the information which they have prepared in the following manner.

2.1 Definitions
2.2 Drawings, Specifications, and Related Data
2.3 Engineer-Owner-Contractor Relations
2.4 Materials and Workmanship
2.5 Insurance, Legal Responsibility, and Public Safety
2.6 Progress and Completion of Work
2.7 Measurement and Payment
2.8 Modifications of the General Conditions

Modifications of the general conditions (2.8) permits tailoring of this document by the engineer to match the needs of the specific project without removing the advantages of having the standard provisions. The division of the general conditions of the contract into eight sections is distinctive of the CEC forms and is intended to permit easier reference by the parties involved.

Special Conditions of the Contract

There are no presently existing and nationally accepted standard forms of Special Conditions. CEC is now in the process of preparing Mechanical and Electrical Special Conditions to supplement CEC General Conditions of the Contract. Nothing has

been officially established, but these items are contemplated for inclusion in the Special Conditions:

- 3.1.01 General Conditions
- 3.1.02 Work Described
- 3.1.03 Drawings
- 3.1.04 Codes and Standards
- 3.1.05 Permits
- 3.1.06 Coordination of Work
- 3.1.07 Equipment Approval
- 3.1.08 Substitutions
- 3.1.09 Catalog Data for Owner
- 3.1.10 Lubrication Charts
- 3.1.11 Excavation and Backfilling
- 3.1.12 Cutting and Patching
- 3.1.13 Materials and Equipment
- 3.1.14 Equipment and Accessories
- 3.1.15 General Piping Installation
- 3.1.16 Cleaning of Ducts
- 3.1.17 Lubrication
- 3.1.18 Pipe and Valve Identification
- 3.1.19 Electrical Work
- 3.1.20 Guaranty
- 3.1.21 Cleaning Premises

Detailed Specification Requirements

While the Legal and Procedural Documents and Bonds, General Conditions of the Contract, and the Special Conditions permit standardization, it is much more difficult to standardize Detailed Specification Requirements. These are generally grouped in the specifications according to the several types of work involved, such as general, mechanical, and electrical. While the drawings show the proportions and relative positions of the various parts of the structure, and indicate in a general way the materials to be used, the detailed specifications define what is to be placed and how it will be placed.

Drawings

The most time-consuming part of the work of the consulting engineer is the preparation of working drawings. Information on the drawings should complement – not duplicate in any particular – the other contract documents. Drawings should show location and quantities of materials; equipment and fixtures; detailed and over-all dimensions; indications of physical appearance; and similar details.

Contract Document Priority

Consulting Engineers Council has assigned the following priority rating to the contract documents in the event that any provision of one contract document conflicts with the provision of another contract document. The provision of the contract document first listed below shall govern, except as otherwise specifically stated:

1. Agreement (between owner and contractor)
2. Addenda to Contract Documents
3. Remaining Legal and Procedural Documents
   a. Proposal
   b. Information for Bidders
   c. Advertisement
4. Detailed Specification Requirements
5. Drawings
6. Modifications of the General Conditions of the Contract
7. General Conditions of the Contract
8. Bonds
   a. Performance Bond
   b. Labor and Material Payment Bond
   c. Proposal Guaranty

A Trend to Standardization

Those contract documents of a general nature must easily fit standardization requirements. This is fairly well indicated by the documents which organizations at work on standardization have prepared. There is a definite movement toward standardizing even the detailed specification requirements of the contract documents. Examples of the organizations that have prepared standard detailed specifications are the American Association of State Highway Officials, American Concrete Institute, American Institute of Steel Construction, American Public Works Association, American Railway Engineering Association, American Society of Civil Engineers, American Society for Testing Materials, American Water Works Association, Associated General Contractors of America, National Lumber Manufacturers' Association, and New England Water Works Association. However, most consulting engineers prefer to write their own detailed specifications for products and materials.

The Hope for Unity

Progress toward greater unity in specification writing must cross three major hurdles. First, the pride of each engineering organization in publishing and printing its own set of contract documents; second, the desire of members of each of the engineers' organizations to be as close to the preparation of standard contract documents as possible; and third, the desire of engineers to have a voice in revising and in up-dating the standard contract documents they use in their practice.

Organizations unresponsive to change discourage engineers in their quest for improvement in this field – as in all others. One step for unity might be the development of a standard Consulting Engineers Council-American Society of Civil Engineers-Associated General Contractors of America form, since the members of ASCE interested in such a form would have similar aims to those of CEC, and many engineers are members of both. ▲▲

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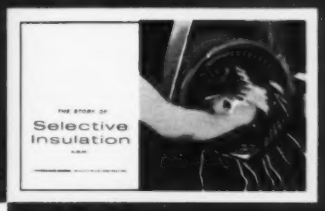
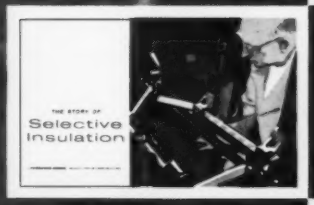
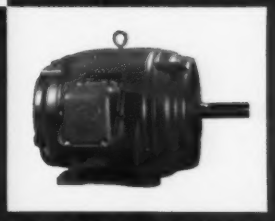


"PROCESS AND MATERIALS"



"SELECTION AND APPLICATION"



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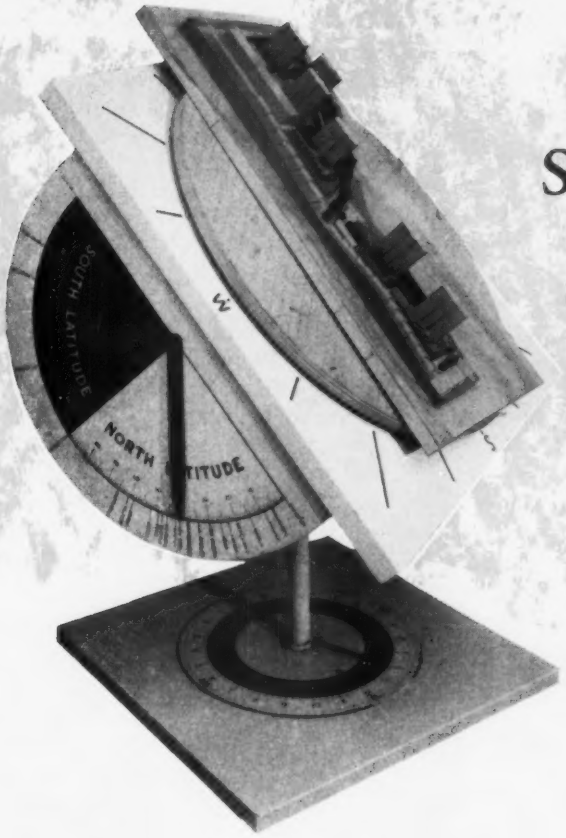

Sunshine and Shadow and Building Design

Voorhees
Walker Smith Smith
& Haines

THE FUNCTION of solar control is to provide sufficient shading for buildings to minimize the ill effects of excessive direct sunlight, solar glare, and solar heat. Short of going underground, it is not possible to provide absolute shading. Nor would it be desirable. In the temperate zones at least, people prefer to get some direct sunlight, and during the cool season solar heat is generally considered most welcome.

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Sun glare can be counteracted quite simply and effectively by providing curtains or interior venetian blinds. However, excessive solar heating presents a much more complicated problem. For efficient solar heat insulation, it is essential to intercept or mitigate the sun's rays before they reach the building – particularly its windows. Although there are ways of achieving adequate external interception of solar heat, it remains a technical problem that taxes the designer's ingenuity. For this reason, the problem of solar control is more one of heat than of light.

Complicating the problem of solar control is the irregular path of the sun which changes the angle of its daily east to west movement throughout the year. While these movements can be precisely plotted, it is nonetheless difficult to satisfactorily provide protection against a source that continually alters its position. On the other hand, this irregularity may be used to provide for the seasonal change in human requirements – sunlight in the winter, shade in the summer. Because of the sun's changing path, methods devised to provide solar protection during the hot season do not necessarily block out the sun in the winter.

New Techniques — New Problems

In recent years, the development of new building components and construction techniques have tended to intensify the problem of sun control. In the past, architectural solutions to the solar problem included thick white masonry walls, umbrella or overhang roofs, wide arcades or loggias, deep balconies, and deeply inset windows. With the arrival of the curtain wall structure, however, most of these devices were discarded.

Divested of some of its former functions, the wall became primarily a curtain to enclose the interior of the building and shelter it from the elements. From a curtain wall composed mainly of

masonry with traditional window openings, it was but a short step to prefabricated sections of glass and metal. Architectural styles changed with the search for a more appropriate expression of the new materials and structural possibilities. On large office buildings and apartment buildings the walls rose higher and higher in smooth, uninterrupted planes. It was soon discovered that bigger and bigger wall areas could be curtained almost entirely in glass panels. The curtain wall had become the window wall.

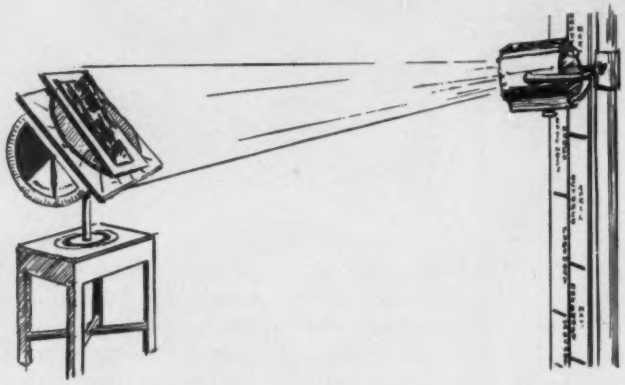
The controversy over the aesthetic virtues of the window wall still continues, but even buildings that do not technically possess a window wall usually contain at least one large area of naked glass. From the point of view of sun control, this development could not have been more unfortunate.

As a barrier to solar heat, an opaque wall is about 10 times more effective than transparent glass. Thus, the larger the area of glass the greater the difficulty and expense of counteracting both solar glare and heat. Largely denied the decorative addenda that often served as partial sun screens, contemporary designers must spend a great deal of time designing shelter for their tall stark walls — particularly where glass predominates.

Overcoming the Solar Problem

There are several methods which, either singly or in combination, can cope with the solar problem in contemporary architecture. Few of these methods are exclusively modern, but with the peculiar twist which today's solar problem has taken, they need to be applied with maximum precision.

¶ Building Shape and Orientation — Planning for solar control begins with the buildings' general design, its over-all shape, and its placement in relation to the sun. Shape must be selected to expose the minimum possible wall perimeter to the sun's direct rays. In temperate latitudes, the best shape



Sun machines are a comparatively recent invention. Until about 30 years ago, building designers had to rely primarily on mathematical calculation when trying to estimate the angle and duration of sunlight on a given area of a building. The only visual aids at their disposal were the graphic translation of these calculations onto charts, and their own trained eye. Or, as pointed out by Aladar and Victor Olgyay in their exhaustive study, "Solar Control and Shading Devices"* — they could use man's original timepiece, the sundial, to formulate shadowgrams which plot the areas of shadow thrown on a given surface throughout the year.

In contrast to these indirect methods, the sun machine provides a direct visual representation of the solar effects on a specific building, structural detail, or group of buildings, at any time of the day and at any time of the year. The machine is a simple device, consisting of a stand to support a building model and a lamp to represent the sun. The subtlety lies in the coordination of both components to reproduce with reasonable accuracy any given combination of three variables — the latitude of the building, which affects the angle and intensity of the solar rays on the structure; the time in the earth's daily rotation, which selects the location of the sun on its path from East to West; and the day in the earth's yearly circle round the sun, which determines the seasonal characteristic of the sunlight on a particular location.

To achieve this coordination, three relationships between the model and the light source are possible. The model may rotate under a fixed lamp, in which case all the variables have to be accounted for in the movement of the model. Or the model may remain in a fixed horizontal position, with the movement of the lamp expressing all the variables. The third possibility is to move both simultaneously.

In the search for greater accuracy, a number of different types of sun machines have been developed. Even now there appears to be no standard. Some machines are extremely complex, while others are quite simple. Some are power driven, others are operated by hand. Some have splendid, neoclassical proper names like Heliodon, Solatron, Solarometer, Solarscope, and Solaranger; others are laconically referred to as "the sun machine" — the generic name.

The sun machine is a valuable aid in the study of sun control. But

The Civic Centre in Rochester, New York, is a good example of a project on which sun machine studies proved invaluable. Buildings are located to the north, east, and west of the Plaza, leaving the south open to the park area beyond. Thus, the Plaza will be sunlit most of the day and the question arose as to whether the shadow thrown by the flanking buildings on the other three sides would be sufficient for comfort. This question was particularly important because the square was to serve as a meeting place as well as a garage roof, and it was preferred that the whole paved area be unbroken by any centrally placed trees or vegetation. This simple model, placed in the sun machine, showed that there would be adequate shade at all times of the day – except at high noon when the sun is almost directly overhead. On the basis of these studies, designers proceeded with the plans for individual buildings as they originally intended.

not every building wilts under an overwhelming sun, nor will every solar problem disappear under the feeble rays of the sun machine. The machine itself is subject to a peculiar type of obsolescence. This is not due to wear and tear on its mechanical parts, but rather to the designer's increasing ability to anticipate the information it will yield. The machine also has limitations, because the rays of an artificial light source, such as a small lamp, diverge rather than remain parallel as do the rays from the sun. Although really precise measurements are not always necessary, this inherent inaccuracy in the machine means that calculations and personal judgment are not eliminated.

For these reasons, many designers do not feel that the machine is a worthwhile investment for their own office. Instead, they borrow a unit from local college or research laboratories when required. At Voorhees Walker Smith Smith & Haines, however, a large number of highly diverse projects are handled each year, and the firm built its own machine in 1943.

Owing to its limitations, it might be assumed that the sun machine is a luxury. Being only a visual aid, this recent invention does not itself improve actual construction methods. It simply throws more light on the nature of the problem to be solved. But more light on a problem results in greater efficiency in its solution. Moreover, recent technological developments in building have in some respects tended to intensify the problem of solar control. The sun machine, therefore, has a peculiar relevance to modern building design which it could not have had in the past.

The sun machine is used in the office of Voorhees Walker Smith Smith & Haines to help in solving solar problems. Its construction is based on the Heliodon designed by Dean Arnaud of the School of Architecture at Columbia University, in 1942. The lamp representing the sun is attached to a movable sleeve on a vertical square pipe and counterbalanced by a weight suspended from a cable inside the pipe. Also attached to the sleeve is a metal indicator that points towards a vertical chart calibrated to represent the months of the year. The sleeve is moved until the indicator is opposite the required month, so the lamp shines at the correct angle on the building model placed on the sun machine table at a fixed distance and direction from the lamp.

The top of the stand is tilted from its basic horizontal position to the correct angle for the desired latitude, and also rotated beneath the stationary light to reproduce the angles of the sun at all hours of the day. When solar effects of a different month are required, the lamp is simply moved up or down to the correct position, and the process of rotating the model repeated. Owing to the physical limitations of the turntable, the model cannot exceed 3 square feet. For a model of a complete building the most desirable scale is 1 inch to 100 feet, though 1 inch to 200 feet can and has been used. For detailed large scale studies on a particular area or component, scale range between 1/32 and 1/4 inches to one foot.

*Published by Princeton University Press in 1957. The Olgyay brothers are both on the faculty of the Princeton School of Architecture, where they have devoted intensive research to the whole problem of sun control. Leading authorities in this field, they have brought out several publications, to which liberal reference was made in compiling the background material for this article.

The Loyola Seminary at Shrub Oak, New York, is an example of the solar orientation which can be achieved when there is no interference from surrounding buildings. In this case, it was desirable that the sun reach the cells of each of the students for at least a portion of each day. The aerial photograph shows a complex but continuous structure which comprises a chapel and all faculty and student facilities under one roof. The chapel stands at the north side, while the faculty living quarters are built around a courtyard and the student living quarters are located in the two splayed arms pointing toward the southwest and southeast. Early use of the sun machine quickly achieved the desired orientation.

Often, solar conditions are immediately obvious, without the use of the sun machine. For example, in the Fresh Meadows apartment housing development in Flushing, New York, the two and three story units shown near the top of the aerial photo required no sun machine studies. However, the solar effects were not so immediately obvious in the case of the two 13 story blocks of complex double cross shape in the center of the picture. The two blocks are placed parallel and relatively close to each other, and are oriented off the grid on a true north-south axis. The problem here was to determine whether the shadows cast by the protruding areas of the transverse wings would screen sun entirely from apartments at the angles.

is generally an elongated rectangular building which is oriented on an east-west axis with the narrow wall turned to the west. Next in efficiency, particularly for solar heat reduction, is the square building which geometrically expresses the minimum perimeter relative to the depth of the building. There also are various complex shapes with protruding parts that will shelter other parts if properly oriented.

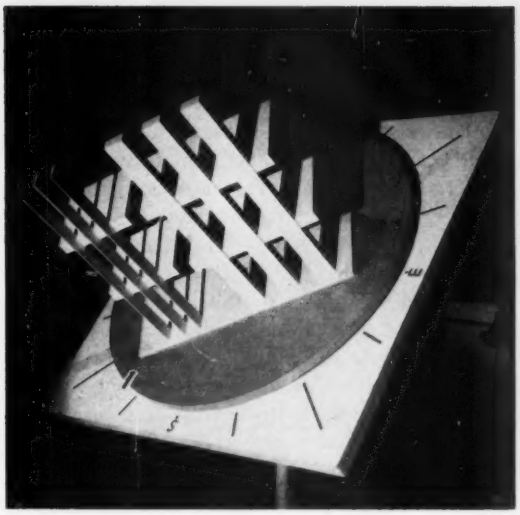
Thus, building shape implies a need for proper orientation with the sun. Large wall areas on the west are to be avoided and important day-long activities must not take place on this side of the building. Instead, it should be used for stairways, corridors, or for services such as cafeterias with limited operating hours. However, since a building is a three dimensional object, the sun cannot be avoided completely. The general principle of orientation, therefore, is to achieve a building placement by which the main walls receive only glancing rather than direct rays from the sun.

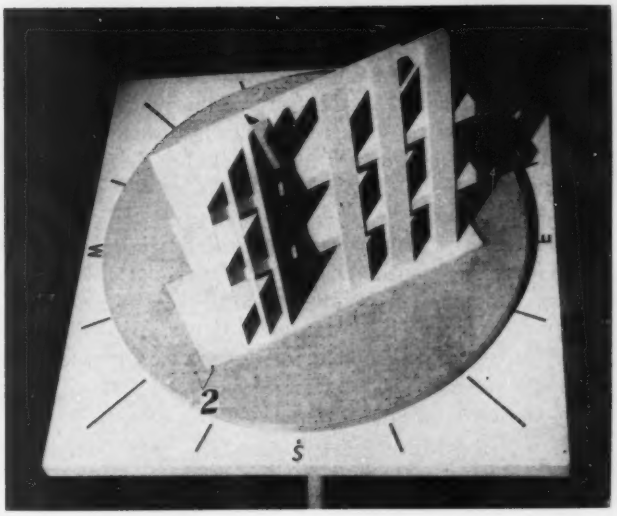
¶ Material Constitution of the Building – Architects could obviously reduce the area of glass, especially on those walls facing west and south. They also could use tinted, heat intercepting glass which reduces glare and intercepts about 40 percent of the solar heat. Similarly, for opaque wall materials, they could choose those with maximum insulation properties. The disadvantage of such methods, in temperate zones, is that they also successfully intercept the desirable heat from the winter sun.

¶ Shading Provided by External Factors – Depending on the site, advantage may be taken from the shadows thrown by other buildings. Or a complex of buildings can be arranged so that sufficient interplay of shadow is provided on the relevant walls of each. But, it is unlikely that the designer can achieve completely satisfactory shading with such methods unless he is exceptionally fortunate in his site. In a complex of buildings there will always be some that remain unsheltered on the outer perimeter. For low-lying buildings, vegetation and trees can be provided as shadow-throwers. Deciduous trees can be selected to shed and grow their leaves in rough correspondence to seasonal demands for sunlight and shade.

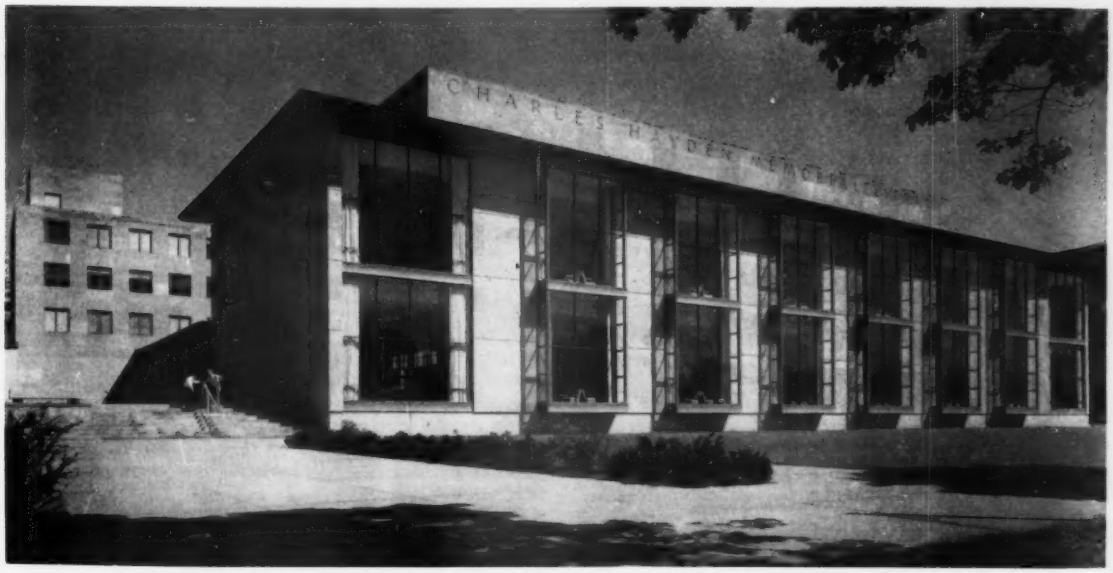
¶ Construction of External Sun Screens – The contemporary solar problem has bred its own contemporary design solutions. To some extent, external sun screens take the place of the balconies, overhangs, and other traditional devices that once used to serve both as part of the building structure and as a means of providing shade. Modern sun screens, in contrast, are constructed for their specific function and are often extraneous to the structure.

There are three basic types of screens; those with horizontal or vertical fins, and "eggcrate" screens





On site work and building orientation, the experienced designer can often anticipate conditions without sun machine studies. A more important use of the machine is in the study of special wall treatments designed to control the effects of the sun. Shown above are two photographs from studies on the sun machine comparing the effects of vertical fins and alternate wall and window openings for two specific times. On the left are shown conditions as they would be at 10:37 AM, on the right at 12:35 PM. Both settings of the machine are for the month of March. These studies were undertaken specifically for the Charles Hayden Memorial Library at the Massachusetts Institute of Technology. The finished building is shown below. On this project, the building's main facade faced south, giving on a room primarily intended for reading and meditation. A considerable window area was naturally required, but it was necessary to protect occupants of the room from excessive sun glare. Thus, it became a question of using the vertical fins or an alternating row of window and wall area. The model in the sun machine showed that by alternating 12-ft wide wall areas with 12-ft wide window openings the room was never in complete sunlight or complete shadow. Rather, a pleasing pattern of alternate slanting bands of shadows were thrown on the floor by the substantial wall areas. Using this design, occupants of the library were given the choice of selecting a seat located either in sunshine or shade.



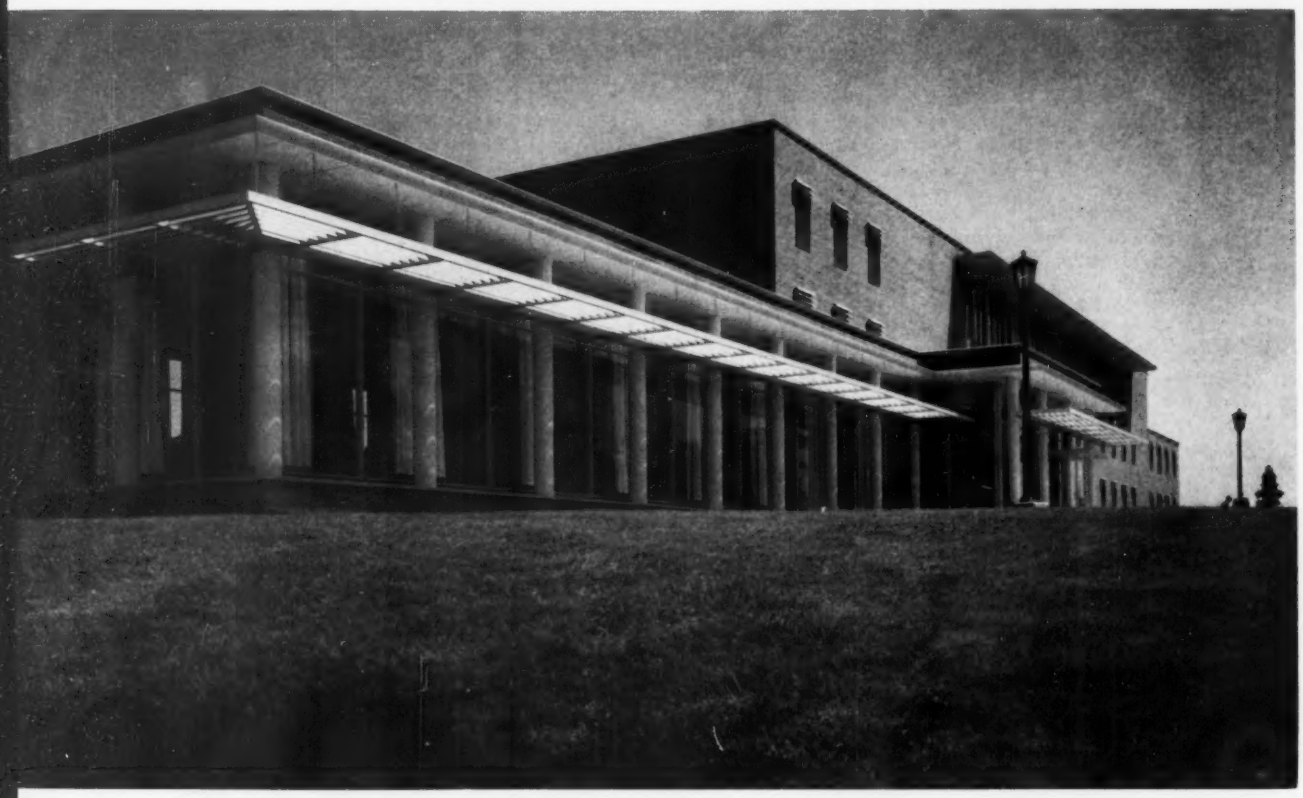
formed by both vertical and horizontal protrusions. However, there exists an almost infinite number of varieties in size, in design, and in method of combination of the basic types. Some screens are in the form of overhangs extending from the roof, some are arranged in the front of the window or wall like shutters, some form balconies, some protrude from the structure itself, some are designed as part of the texture of the wall material, and others are tacked on from the outside.

Sun screens have considerable aesthetic potential for enhancing the textural appearance of otherwise stark modern buildings. Correctly designed, they form an excellent permanent device for shading the walls without either wholly blocking the view or intercepting the winter sun. Much detailed calculation is required to position the screen fins so that this composite aim is achieved. Sun screens are neither cheap nor easy to erect, and proper design is essential to justify their use.

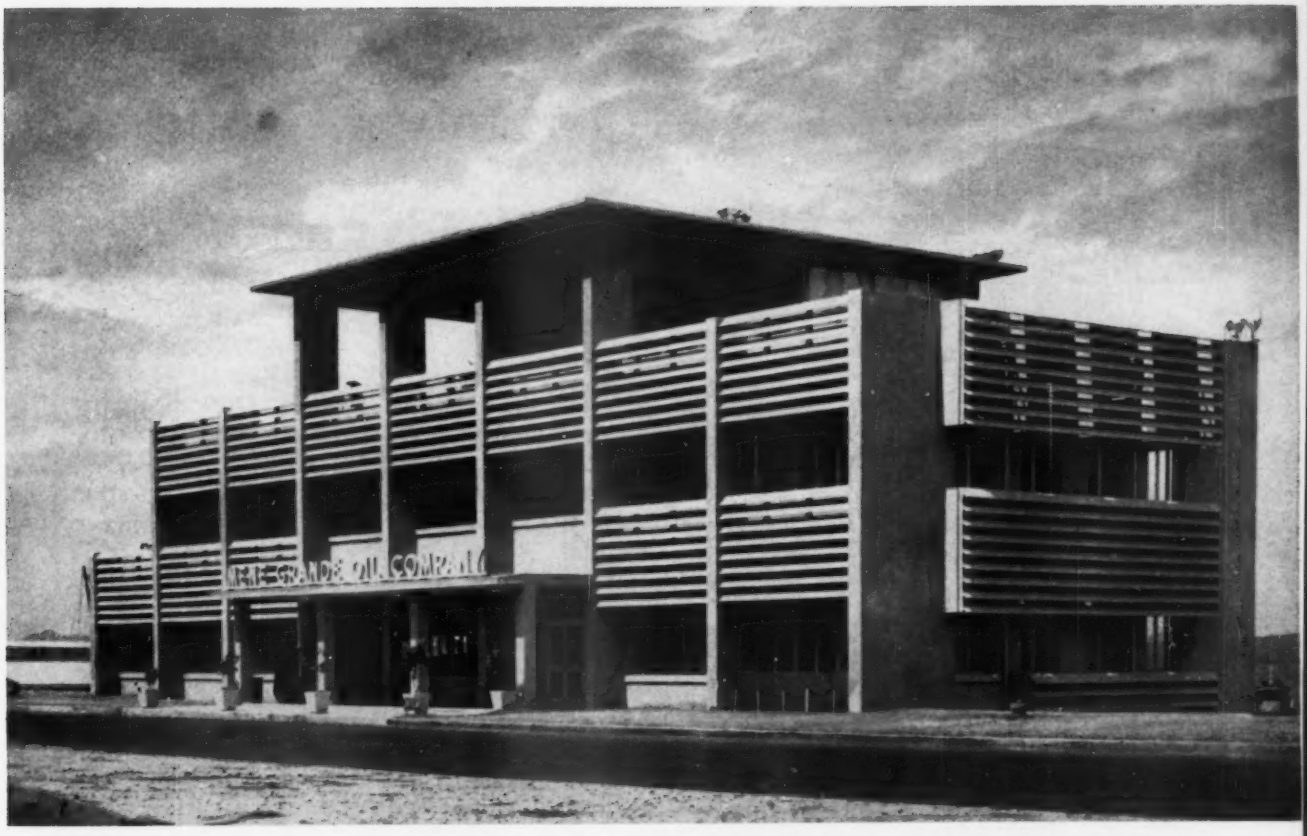
¶ Miscellaneous Semipermanent Screen Devices – Both interior and exterior shutters have been used as solar barriers for generations. Interior screens are not very effective against solar heat, unless they are painted on the outside with a reflective color such as aluminum or white. They have certain economic disadvantages too, because they are short lived and require considerable maintenance and frequent washing. Initially far cheaper than permanent external sun screens, they may prove much more expensive in the long run because of the attention they require.

External semipermanent shutters, often of wood, have some of the same economic drawbacks. Moreover, owing to their structural limitations they are not nearly so effective as the fully developed sun screen. In addition, they prevent the free passage of cooling air.

¶ Air Conditioning – Strictly speaking, air conditioning can hardly be called a method of sun con-



The cafeteria of the Washington Research Center of the W. R. Grace & Company has a view on all sides except the east. The sun screen is in the form of a 7-ft wide overhang suspended from a roof overhang above the window wall. On this exposed site, the roof itself would have provided insufficient shade. However, with the addition of screening designed so that it would not block out all the natural light, it was found on the sun machine that adequate shade would be provided at all times of the day except the late afternoon. Since the cafeteria is not then in operation, there was no need for additional screening.



External sun screens on the Mene Grande Oil Company office building at Puerta la Cruze, Venezuela, were tested on the sun machine before design was finalized. At this latitude, 10 degrees north, it is hot all year round, and the reinforced concrete building is entirely unheated. Horizontal sun screens were placed between floor levels and slightly overlap the bottom and top of each window height. The angle of the matte finish aluminum fins deflects the sun's rays and casts a shadow on the exterior walls. Constructed on all sides of the building, the louvres were placed at a distance of 3 feet from the wall to create a flue for drawing up the breezes and providing an additional method of cooling the walls. The position and design of the screens was carefully tested in the sun machine to be sure that they would provide maximum effect.

trol. Nevertheless, it is the latest and most effective means of counteracting solar heat. Theoretically, it can reduce the problem of sun control to a minimum, relying only on curtains or blinds to counteract sun glare. However, air conditioning is an expensive commodity, and its cost is dependent upon carefully planned and efficient use of the various methods of sun control.

It is interesting to note that in terms of building shape, orientation, and material construction, air conditioning has created its own ideal functional requirements — different from those for buildings without it. The ideal building shape for the lowest air conditioning load per unit area, all other factors remaining equal, is the square. With it the minimum perimeter, relative to the depth of the building, is exposed to the elements. Air conditioning has made the large square building possible and at the same time, this building shape creates ideal conditions for air conditioning.

However, in order to cut costs, it is important that a long unsheltered wall does not face west or south. In the latitude of 40 degrees north, the south wall catches much of the autumn and early winter sun. Heat from the winter sun may keep the cooling system on the south side of the building in operation until well into October — while the north side occupants are already demanding heat. Under these circumstances, the owner has to incur the added expense of maintaining independent cooling units or extensive controls. The ideal material constitution of an air conditioned building would consist of entirely opaque (and insulated) curtain walls without window openings. Such buildings have been built, but their desirability is controversial, except for special cases. ▲▲

Hubert Gautier, 1660-1737, author of the first book to be devoted entirely to design and building of bridges.

Hubert Gautier's Roads and Bridges

JAMES KIP FINCH, Dean Emeritus
Renwick Professor of Civil Engineering
Columbia University

WITH THE DEATH of Louis XIV, in 1715, and the organization of the Corps des Ponts et Chaussees (equivalent to a National Department of Bridges and Roads), French engineering was no longer at the mercy of an all powerful monarch. By the late 17th century, French engineers had already achieved leadership in the profession, but the newly created Corps was to bring even greater triumph. Along with it came the publication of many important French engineering books, some of them worthy of being classed with the greatest and most interesting ever written.

The author of two of these great works was Hubert Gautier, born in 1660 in the old Roman city of Nimes, in the south of France. Initially educated for a career in medicine, his mathematical interests are said to have turned him to engineering. After busying himself for a time in marine work, he began a 28-year career as Engineer of the Provence of Languedoc, where the Canal du Midi and other notable works gave him a broad and varied experience. In 1716, he was named an Inspecteur des ponts et chaussees, a post he held until his retirement in 1731 at the age of 71.

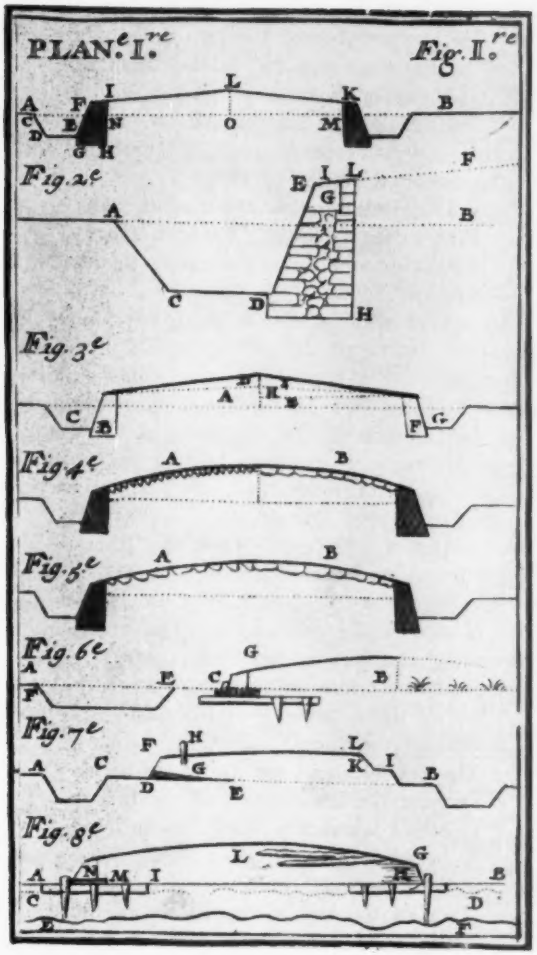
Gautier's career paralleled the earlier years of the Corps. His engineering publications, long accepted as standard works, passed through a number of editions and undoubtedly aided in the work of the Corps and in stimulating technical progress. He was a prolific writer on many subjects, but his two great engineering books — one on roads and the other on bridges — were engineering classics of the 18th century.

His book on bridges, published at Paris in 1716, was the first book to be devoted solely to that subject. It went through four editions, the last in 1765, and remained a standard text until the appearance of Gauthey's works some 70 or 80 years later. In 1715, his book on roads appeared. It was also a pioneer text, but technically less important than his book on bridges. It went through at least four French editions, and a German translation.

Traite des Chemins

Gautier left no doubt on the title page as to the contents of his books. The title page of his book on roads reads:

> Treatise on the construction of roads, Wherein it is spoken of those of the Romans, & of those of the moderns, followed by the practice in France; Of their Shape; Of their materials, & of their location in all sorts of terrain; the De-



Gautier showed French reliance on surface more than foundation in his "Traite des chemins:" "The earth we dig out of the ditch, & that for placing of the foundation of the walls, should be thrown in the middle of the Road between the two walls, so as to form with it a gentle slope on each side. This slope is to be regulated by a stake, which those who have the supervision of the Road should put at the center of the roadway; after determining the height of the retaining walls, by other stakes set above the level of the ground, one then secures an even line at the height of the slopes which are to be given to the top surface of the road. The Romans, in the main Royal Roads, which were of 60 feet in width, gave 20 feet to the paving of the center, which, nearly level, was the part of the Road most elevated in breadth. . . . in our main roads we imitate them, proportioning their width: we are able to keep the same plan for the paved roads, but we do not with those which are surfaced with earth, or with gravel, in which the continuous movement of wagons does not bear down so heavily on their top. The newly placed earth of the Road is not immediately to be compacted, as some will claim. Two or three months of time, some rain, and those who pass over the Road better assure this than if we compact with women and girls for many days; this is an unnecessary expense for the contractor."

crees, Edicts and declarations of the King concerning bridges and highways.

Of the Paving of Main Roads, & of Streets in Cities.

Of the map of Ancient Gaul, where the Roads of the Romans are traced according to the Itinerary of Antoninus, which records the places he traveled to in France.

To which there is also added:

A dissertation on projects for canals for navigation, for irrigation and the supply of fountains

A dissertation on the delivery of masts for the vessels of the King, from the forest where they are cut, to the sea ports to which they are destined.

There is a wealth of interesting information in this volume. Roman roads clearly served as models for French works, for, as Gautier notes, "there is no doubt they [the Romans] followed the same needs for which we plan. Our main Royal Roads stretch in a straight line such as they sought to provide, are of a width suitable not only to the needs of the people & of the vehicles which pass over them, & also are of a composition capable of resisting rain, & the injuries of time, & the wear which follows and results from traffic." Yet the problem of developing a form of construction which would effectively meet these needs and yet be less costly than the Roman road was not solved until Tresaguet anticipated, in 1775, the type of construction Telford later adopted in Britain.

In Gautier's day, the emphasis appears to have been on providing a surfacing less costly than the Roman, but with little attention to the securing of a firm base. Although French roads were reported to be far in advance of those in Britain, rivers and canals still remained almost the only practical, economical means of inland transportation. Thus, Gautier's work is primarily of interest as a history of routes and as a record of earlier highway organization and administration in France.

He notes, "In France the King has the sole right as sovereign over the roads and it is for this that there is established a grand Voyer (i.e., inspector of highways) and the Treasurers of France provide for the extension and shortening of Roads for the use of the Public." The rules and requirements for the construction and repair of the heavily traveled Paris to Orleans road are given, and it is noted that the contractor was required "to guarantee the work for 10 years from the date of completion." A six year guarantee was required for earth roads. Women as well as men were employed in construction, and *corvee*, or forced labor, as well as a poll tax were imposed on those whose

properties bordered the route. This contributed to the unrest that brought about the Revolution.

Traite des Ponts

The title page of the 4th Edition of a second engineering classic, "By the Mr. Gautier, Architect, Engineer and Inspector of Bridges and Highways of the Royalty . . . published in Paris in 1765 with the approval and permission of the King," again outlines in detail the contents:

> Those bridges of the Romans and those of the Moderns . . . both those of masonry and of timber . . . the Materials of which they are built, their Foundations, their Scaffolding, their Centering, of Machines and Cofferdams . . . Of the different kinds of Bridges, Standing or Fixed, Swing & Floating, Movable, Turning, to Slide, Drawbridges to Rise & to Rock (bascule), & c. . . . all the Terms of the Art, of Figures showing their various parts . . . Edicts, Declarations, Orders & Ordnances . . . for Bridges & Highways, Streets, Ferries, Rivers; of the Practices observed in their making, of their construction, of guarantees, of Tolls & of rules for wagons.

To this impressive list was added (probably first in the extended edition of 1725):

> A Dissertation on the Abutments, Piers, Ring-stones & Thrust of Bridges, & many Estimates and Rules pertaining to this subject.

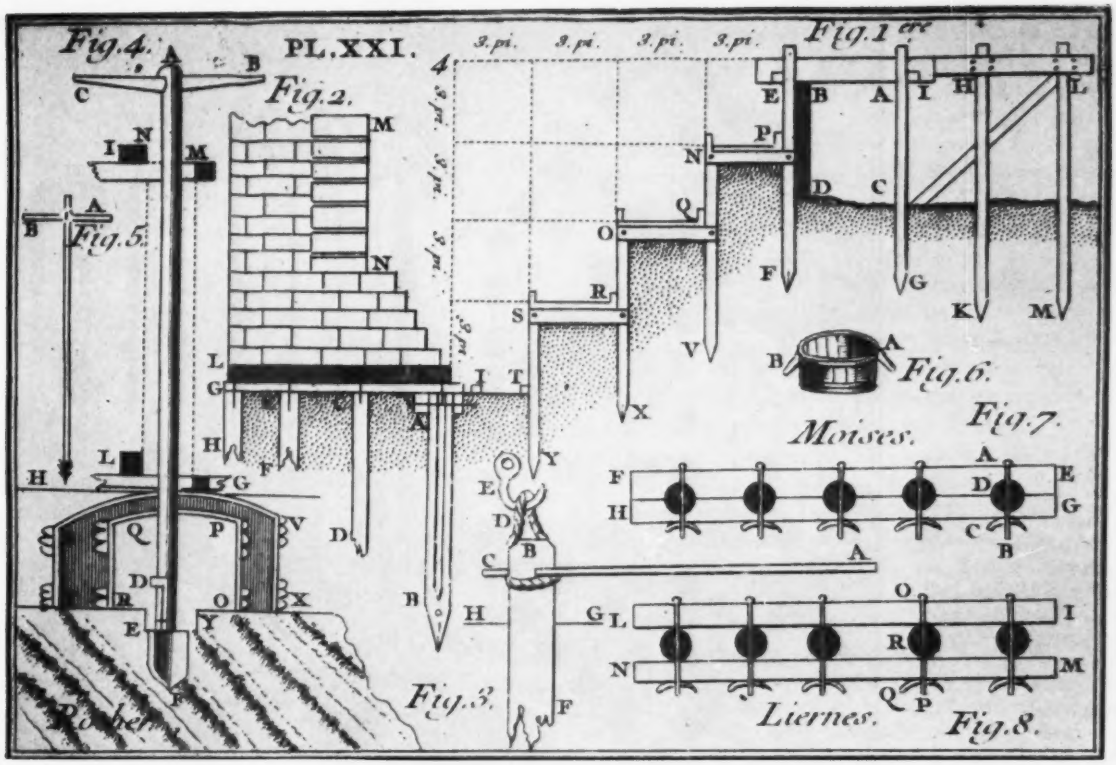
An octavo volume of 436 pages containing 30 engraved folding illustrations or figures, this work offers an excellent summary of the bridge building practice of the day. It also reveals the problems and the interests of the engineers of the Corps. There are no new forms of bridges proposed in this book. Descriptions and plates show earlier bridges, including Roman stone arches, Caesar's famous timber pile-bridge over the Rhine, Palladio's trusses and trussed arches, and such notable earlier French works as the Pont Royal and the Pont Neuf over the Seine at Paris. One of the most interesting chapters is the 38th, devoted to the specifications for three outstanding French bridges. The first of these is the Pont Royal. The chapter is headed by this title:

> The Specifications for the works necessary for the construction of the Bridge of stone which the King has ordered to be made over the river of the Seine at Paris, between the center of the large Wing of the end of the Palace of the Tuilleries, following the Plans & Elevations which have been made by order of His Majesty.

It begins with a general description of the bridge, including such details as length and height of spans. There is then described "The Qualities & kinds of materials which are to be employed in the construction of said works." Thus: "All the mortars of lime, & cement are to be composed of two fifth parts, (the five makes the total) of good lime of Melun; and the three other fifth parts of good cement of tiles, or tile-pipe, & not of bricks; the whole well ground, & mixed the one with the other." Since the famous Roman pozzuolanic admixture was not available, the substitution of ground tile produced at least a semi-hydraulic cement which would harden in bulk or under water. Strong stone from various specified sites was required, the voussoirs of the arches to be of "the stone of Vergele."

Construction requirements provide for the cofferdams (batardeaux) "necessary to stop the water, & to hold the interior dry at all times when needed, both for driving the piles and for found-

Frontispiece to the first book on bridges, Gautier's "Traite des ponts," showing three arch forms: semicircular (full-centered), elliptical, and pointed.



Gautier's book on bridges showed plans for a stepped cofferdam, similar to the one said to have been used in building the piers of the Pont Neuf in Toulouse. This stepped form permitted a deeper excavation than could be made with manually-operated pile drivers. Figures 4 and 5 on the left represent "a great auger for boring a rock . . . so as to plant a pile below the water level." It was apparently his own invention.

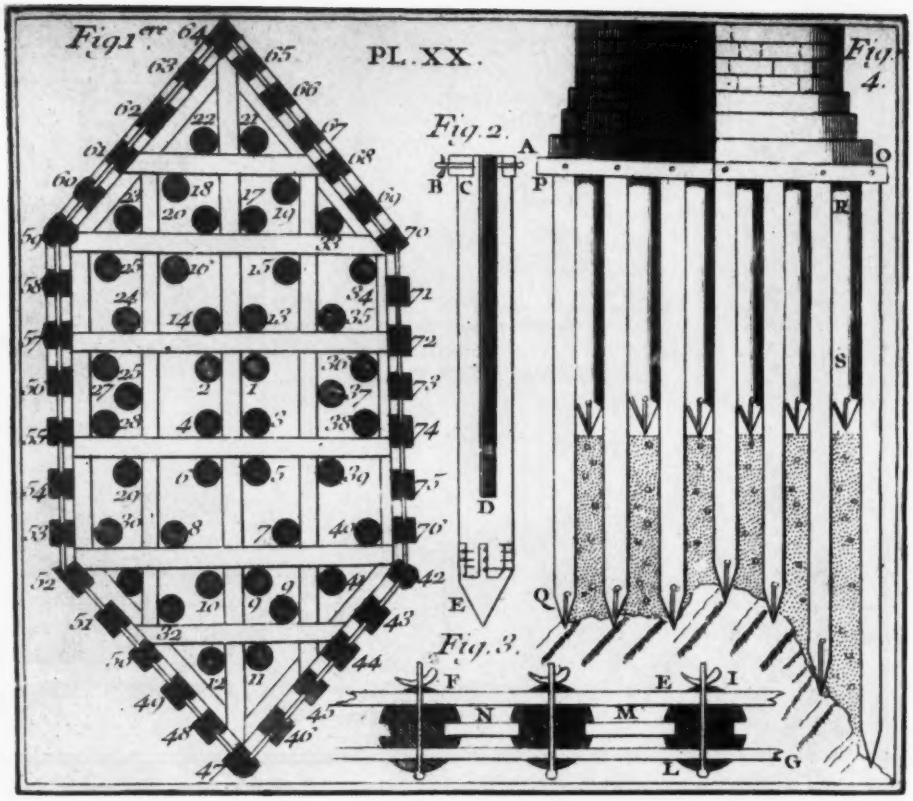
ing the piers and the abutments of the said Bridge." A description of these cofferdams, "each constructed of two lines of stakes, 2 or 3 feet apart, driven into the ground as is necessary so they will sustain the thrust of the clay, & of the water . . . at all times when needed, at the risk, peril and fortunes of the contractor." Actually, this foundation method is said to have proved unsuccessful. Father Romain, called from Belgium to take over, is said to have sunk "a Marne barge" in an excavation in the river bottom made with a dipper dredge operated by a huge "walking-wheel," or man operated tread-mill. He succeeded in building the pier inside this barge, thus originating the *caisse* or box — today known as the caisson.

Gautier's specifications were expressed in distinctly modern terms, and the contractor's payment was established on the unit price basis so widely used in engineering construction today. Thus:

"For the construction of all of which works the contractor is to furnish all the tools, engines, mills & other machines, & labor of workers necessary for removing the water, & place and maintain, all the time when needed, the cofferdams to stop it; to furnish & have made the centers necessary for the construction of the arches . . . for which no payment is to be made to him other than the price hereafter agreed upon for each cubic toise of cofferdam, piles, volume of piers, abutments, cutwaters, & arches, as is said below."

The Corps had no sooner been organized than its skill was challenged by the failure in flood of the long bridge over the Loire at Blois. Specifications for its replacement are included in Gautier's book, as well as those for a quay wall and timber bridge at Paris. It is interesting to note that Gautier regarded it necessary to watch closely the *entrepreneurs*, or contractors, of his day. "The contractors do not hesitate to enrich themselves at the expense of the King or of those who work for them; & the engineers or inspectors of works, on the contrary, have only in mind the honesty with which they act and to be highly esteemed; & they do not hesitate to regard the former as their enemies, when they are unfaithful."

These fascinating revelations of the engineering construction of two centuries ago are matched by Gautier's observations on the relationship of art,



Gautier's bridge plans included this one for a foundation built on top of a timber grillage, formed on "piles filled with rubble to the number of 41." He included a protective avant-bec, or starling.

engineering, and science. Gautier was one of the first engineers to react against the emphasis on the artistic approach in bridge design which prevailed in the Italian Renaissance. At the same time, he took to task the scientists of his day whose interests were almost completely absorbed in mathematical studies and speculations. Thus the Preface to his book begins:

"The Authors who have treated of Architecture, have not given any rules for the Construction of Bridges. They have not treated this matter exhaustively, nor given any details; they have only mentioned it in passing, they have assumed that the Architect who knows everything concerning his Profession, was bound to know all there is concerning bridges.

"The most able Architects do not agree among themselves . . . they do not give us any demonstration of their reasons . . . The proportions which they give to their constructions are related not only to their stability but at the same time to their decoration, thus it is true that the Arts and Sciences are still very defective. It all depends on a particular taste, on particular ideas in which men differ one from another & in different ages, & which they follow without being able to give any reason."

Turning to the lack of any practical and useful results stemming from the science of his day, he complains in particular of "Monsieur de la Hire of the Royal Academy of Sciences," whose work *A Treatise on Mechanics*, published in 1675, "is not comprehensible to those who are not savants as he is and who do not understand Algebra, for it is filled with the abstract terms of this Science, which Workers and semi-savants do not know, & in consequence which they do not understand, and for which they have no use."

Gautier follows this up in Chapter XXX where he offers:

> Five problems which we propose to the savants to resolve.
>
> What must be the thickness of an abutment for all kinds of Bridges & Archways of masonry, in proportion to the height of Arches & Archways, & the weights which they must support.
>
> What must be the width of the piers in relationship to the span of the Arches & Archways, & the weights with which they are loaded.
>
> What must be the bearing of the ring stones, from their intrados, to their ex-

trados; for all sizes of Arches & Archways at the place of the Key.

And finally, of all the Arches (and Archways) of the same span what is the best to carry the most heavy burden? What proportions (form), the one or the other, better carries their forces, shall it be an ellipse, or of what shape shall we make it?

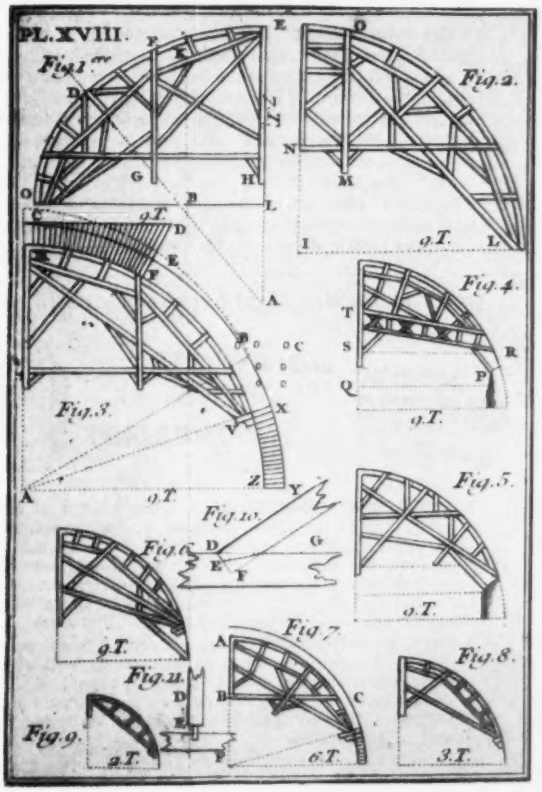
To those four propositions we add a fifth, which is, of showing exactly what is to be the profile of retaining walls, for retaining the earth of a road, of embankments, of terraces, of the ramparts in fortifications of all heights, &c.

Marshall Vauban, he states, has given a similar profile for fortifications "for which purpose this profile has always been used with success, but since it is founded only on experience we ask for a demonstration of it with the solution of the four preceding propositions, the hypothesis to be taken as principals must be known, certain, evident and undoubted." To which he rather amusingly adds the worthy admonition, "We require that these things be stated in clear terms & in known language, so that everybody understands them & can form an opinion of them."

Gautier devotes a chapter to each of his five queries and ends with "A Table of proportions of all the principal parts of Bridges & full-centered archways, from a little arch of one foot span, to an Arch of 20 toises or 120 feet, of their different abutments, of their piers, & of their voussoirs." This table, he observes, "shows the sizes of voussoirs from their intrados to their extrados based on proportions taken from the Authors & the earlier Works, which we have expressed through the just Rules of Geometry for their demonstration" and, he cautions, assuming "the solidity (strength) of compact stones."

Thus Gautier was forced to be satisfied with proportions drawn from past experience. Yet, even today, one "designs" a voussoir arch (and also so-called statically indeterminate structures) by assuming what appear to be suitable proportions judging from earlier successful arches and then checking and modifying this tentative design to accord with an analysis by structural mechanics. It is still true, as the great modern exponent of the stone arch, M. Paul Sejourne, puts it: "On fait une voute d'apres les voutes faites: c'est affaire d'experience." (One makes an arch after arches that have been made: it is a matter of experience.)*

It would be unfair to attribute to Gautier alone the initiation of the movement toward the practical science of engineering which went forward in France throughout the 18th century. There were many other workers who made important contributions to what Belidor was to call "La Science des Ingenieurs." Gautier, however, clearly and forcefully detailed the shortcomings of the architects' artistic approach in planning bridges and the failure of science to produce any help in developing more accurate and effective design techniques. It was not until the mid-19th century that engineering science actually began to play an important role in design. By this time, the development of iron and the steam engine had added economic pressure to a search which, in earlier years, was largely prompted by curiosity rather than pressing practical needs. Yet Gautier's *Traite des ponts*, the first book on bridges, unquestionably marks the dawn of a new era in the history of structural engineering design. ▲▲



Timber centers to support arches during construction were more interesting subjects than timber bridges. Gautier noted: "One cannot make a bridge of masonry without a center, which is the mold of the Arch. . . ." When the centers are struck, warns the author, "one is made aware of mistakes which had not been forseen."

*From Sejourne's monumental 6-volume, *Grandes Voutes*, Bourges, Tardy-Pigelet et fils, 1913 — an engineering classic.

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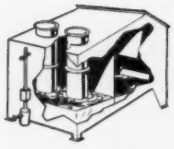

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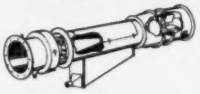

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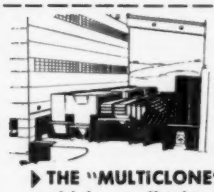

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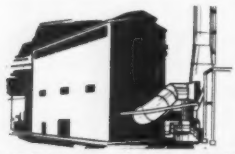

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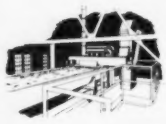

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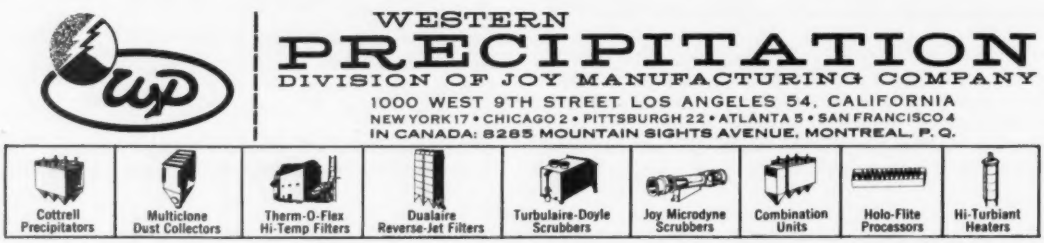

Design of Two-Way Voided Lift Slabs

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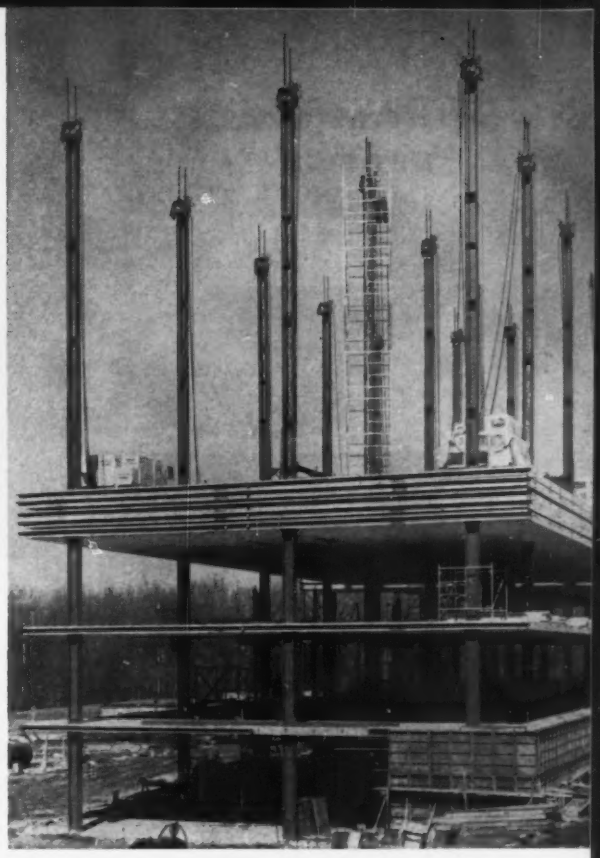
Samborn, Steketee, Otis and Evans



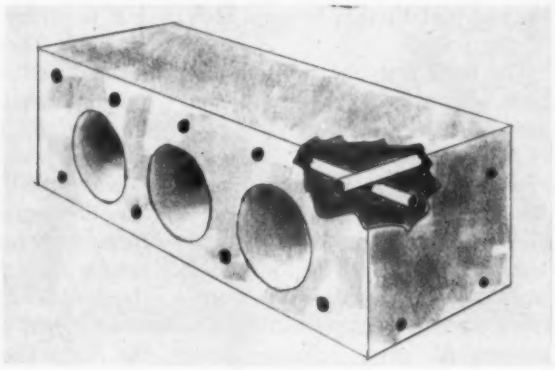
Upper floor and roof slabs are ready to be raised into position after upper columns have been field spliced. Slabs for each floor were built in two sections.

THE TWO-WAY voided lift slab, as the name implies, involves a design in which voids as well as reinforcing are placed in two directions. This unique design approach combines the advantages of the lift slab method of construction with the maximum use of voids where concrete is not required for shear or moment.

As first used on "Crestview of Ohio," a six-story housing project for senior citizens at Sylvania, Ohio, this new technique allowed a dead load reduction from 125 psf to 84 psf. This dead load reduction resulted in a considerable saving in column footings, slab reinforcing, and concrete in the six-story, 227-ft long by 53-ft wide structure.

The two-way voided lift slab method has many practical advantages in both construction and design, and offers economies not readily apparent. One inherent advantage in construction is a lighter slab with less mass to be raised by the lifting jacks. With the maximum use of voids, not only a lighter, but a thicker and stiffer slab is provided. In the Crestview project the slabs were 10 inches thick, and both 5-in. and 6-in. diameter fiber tubes were used to create voids. This slab depth minimized the problems in the critical column shear head area. At the same time, it reduced deflection, thus simplifying the construction problems created by unequal deflection between slabs. In addition, where movable partitions and siding are used, the stiffer slab minimizes the construction problems of caulking, and maintaining plumbness and clearance.

The two-way voided lift slab design retains the advantages of maximum interior partition flexibility and completely optional ceiling treatment typical of the flat slab design. Enhanced exterior appearance also may be achieved by the use of cantilevers. The stiffness of the deeper voided slab reduces the sine wave effect which is often found in flat slabs having relatively long spans.



Two-way voided lift slab has both voids and reinforcement running in two directions. Lighter, deeper slab reduces footing size and increases the stiffness.

Cost Factors

While the cost of the two-way voided lift slab in place may ex-

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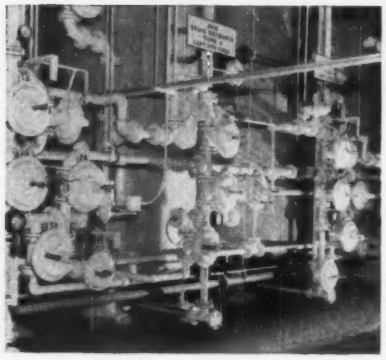
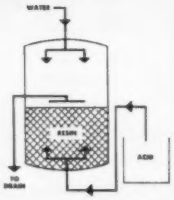


Right, a diagram of the IWT Counterflow* system of regeneration, whereby a downward flow produces a "barrier" to keep the bed from being expanded by the upward flow of regenerant.



DISSOLVED SOLIDS IN RAW WATER REDUCED FROM 570 TO 3 PPM USING "COUNTERFLOW"

At the Hiram Walker distillery in Peoria, Illinois, the IWT equipment shown above is used to provide purified water for adjusting proof of various alcoholic beverages. It consists of *automatic* Counterflow* cation exchangers, automatic weakly-basic anion exchangers, and a vacuum degasifier. The de-ionized water is suitable for beverage use *without any need for activated carbon filtration*, because the resins used do not add any taste, color, or odor to the water. The equipment, after 2½ years, is still giving rated capacity of 140,000 gallons in each 24 hours. Quality, proposed at 5 ppm, actually runs mostly at 1 ppm with a maximum of 3 ppm. Counterflow* regeneration provides lowest operating cost through reduced regenerant dosages.

* U.S. Pat. 2,891,007

IWT LEADS THE WAY

The experience which enabled IWT to produce this excellent performance at Hiram Walker has been gained through intensive pioneering in the important phases of the ion-exchange process ever since its introduction in 1937.

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"Crestview of Ohio" is an attractive new housing project for old people. It is said to be the first two-way voided lift slab structure in the U. S.

ceed that of other conventional methods of construction, the savings realized by eliminating or lowering costs among the various construction trades will often make a voided lift slab more economical than conventional slab design. Cost advantages include:

¶ Savings from reduction in volume and weight of concrete resulting from maximum use of voids. However, it should be pointed out that on the Crestview project the additional cost and placement of void tubes very nearly offset the saving in concrete.

¶ Savings in footing costs due to the reduction of dead loads.

¶ Savings in ceiling costs by elimination of suspended systems.

¶ Savings from reduction in building heights over conventional construction methods due to lessening the required distance between each of the floors.

On the Crestview project, column centers in the long direction are at 24½ feet, with a middle bay of 28′ – 8″, and a cantilever at each end of 1′ – 4″. In the short direction, column centers are 18½ feet and 24 feet, with 5′ – 4″ cantilevers at each end. The void tubes were placed along the short direction of the building, with the exception of outer column lines, where the tubes run the long way. Tubes were 6-in. in diameter on the typical floor section, except in the exterior longitudinal column strip, where 5-in. tubes were used. On the roof slab all tubes were 5-in. in diameter. All tubes were placed 8 inches on center, and were tied to the bottom layer of the reinforcement, eliminating usual tie-downs.

The use of voids eliminated the need for bent reinforcing bars except, of course, for the shear steel bars. Reinforcing bars lying in the direction of the tubes were placed between the tubes, on roughly 8-in. centers. Where the bars ran at right angles to the tubes, the spacing was established according to the design requirements.

Building columns were designed to be free standing during erection and to withstand a wind force of 100 mph. The columns were firmly secured to the top of the concrete caissons which extended down through the earth to solid rock. Columns were spliced in the field between the third and fourth floors. The first tier of columns extended from the ground floor slab to a height of 35 feet, or 5 feet above the third floor. This provided ample space when upper slabs were in the raised position. ▲▲

EH G g JK TJ TJK eh K F jk LM NF tef
NE NM TEF KL TKL LM EH TJ jkl EH k
K EH G JK TJK JK TEF NF Mm TKL eh
F JK LM NF Mm tef EH JKL G eh JK TJ
K EH tjk JK NF LM F G TJK Mm KL nm
TJK JKL TJ G jk TKL NJ KL JK EH tjk

in specifying AB breakers the reign of confusion is over

Westinghouse completely redesigns its breaker line

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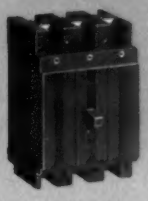
Newly designed breaker line simplifies frame designations . . . reduces space requirement up to 50%. Because of recent Westinghouse engineering advances, these new breakers retain the same high interrupting capacities of older designs in smaller frame sizes. The new designs mean it's easier for you to order, install and use AB breakers. Gone is the confusing assortment of letters that designate other models. These new breakers are easy to identify because they follow a common-sense sequence. They're simple to specify because you choose from only six breakers for virtually every application. They're better to use because they're smaller . . . yet you have the same quality and reliability of the former Westinghouse models you've been using.



E 15-100 amps, 240 volts a-c,
125 volts d-c, 1, 2 and 3 poles
IR @ 240 volts a-c: 7500 amps

FA 15-100 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 20,000 amps
Replaces: EH, F and G breakers
Check Westinghouse for availability of this newest breaker.

JA 70-225 amps, 600 volts a-c,
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IR @ 240 volts a-c: 25,000 amps
Replaces: J breakers

KA 70-225 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 30,000 amps
Interchangeable Trip
Replaces: JK and K breakers

LA 125-400 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 50,000 amps
Interchangeable Trip
Replaces: KL and JKL breakers

MA 125-800 amps, 600 volts a-c,
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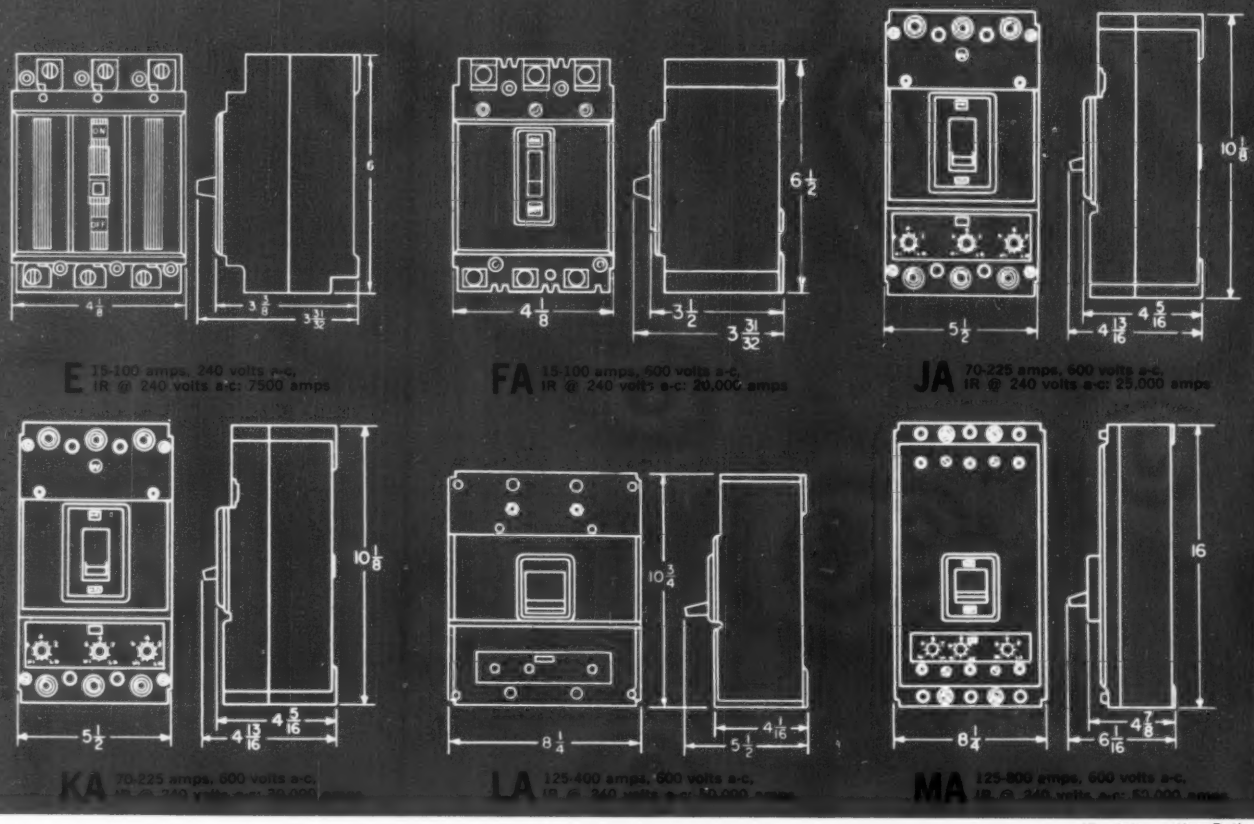
IR = Interrupting Rating

• Add the fact that terminals accept either copper or aluminum cable. Any way you look at it, the **NEW** Westinghouse line is the one you'll want to use from now on. • Want more information on this new line of breakers? Contact your Westinghouse representative, Westinghouse distributor, nearest independent panelboard-switchboard builder, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. • We're offering a free wall chart that shows the new line of breakers. It measures 17 x 22 inches, is plastic coated and gives dimensions, interrupting ratings, maximum amps and volts and, of course, the newest designations along with the breaker photos. Write to the Westinghouse address above for your copy.

All Westinghouse AB breakers meet or exceed NEMA and UL specifications.

new breakers / new sizes / new designations



IR = Interrupting Rating

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MARK 75* . . . interrupts up to 75,000 amps at 240 volts a-c. Costs a fraction of conventional high interrupting capacity breakers. Does not require reactors or fuses, is particularly suited for network systems.

TRI-PAC* . . . smallest, lowest cost protective device you can apply where 100,000 amps can be poured into faults. Example: network systems or those fed by large transformers.

THERMAL MAGNETIC . . . provides instantaneous opening on short circuits, yet permits harmless momentary overloads such as those encountered in motor starting and initial lighting surges. On sustained overload, the higher the current, the shorter the opening time. All frames.

AMBIENT COMPENSATED . . . ends nuisance tripping, and eliminates need for derating where elevated or changing temperatures are encountered. All frames.

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WESTINGHOUSE ELECTRIC CORPORATION Standard Control Division, Beaver, Pa.

*Trade-Marks

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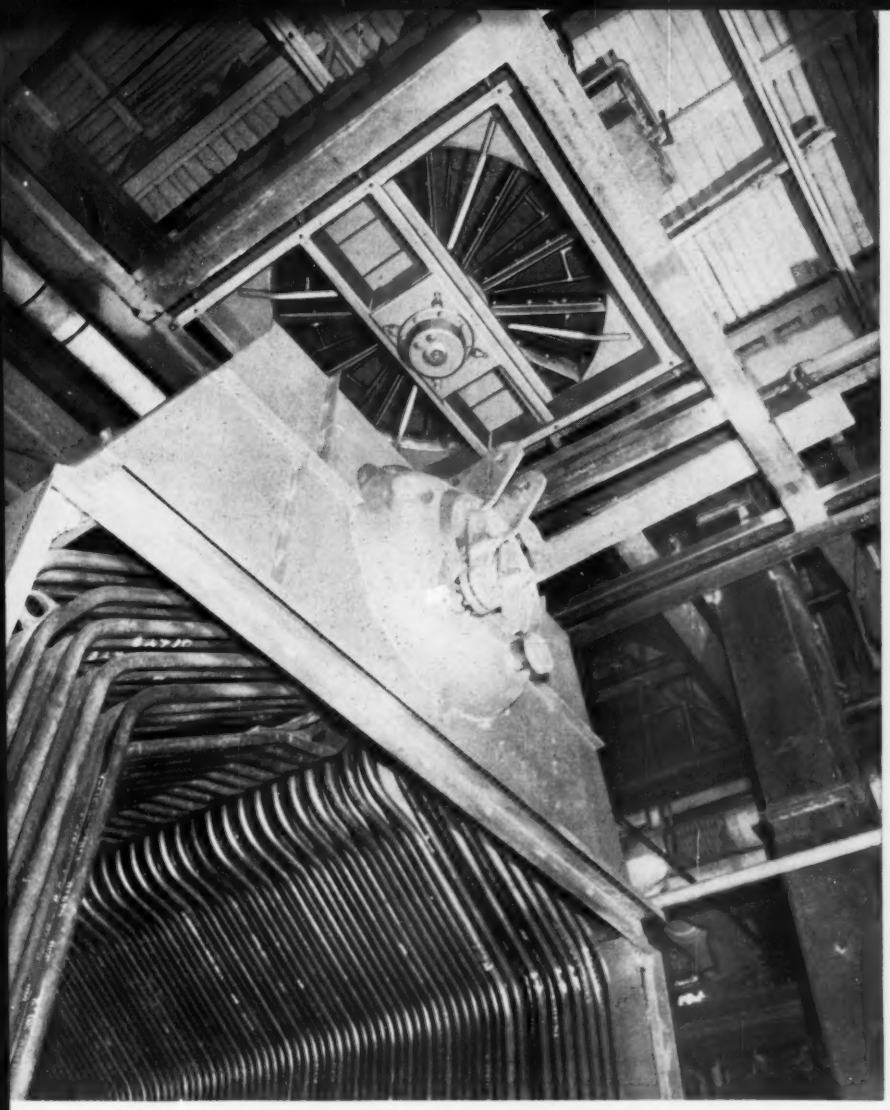

The Ljungstrom Air Preheater at the B. F. Goodrich Company Shelton Plant is installed directly over the 65,000 lb/hr Wickes boiler. Flue gas leaving the boiler at 615°F passes through the circular rotor, which absorbs the heat and releases it into the incoming air. Preheated combustion air improves combustion, makes fuel burn cleanly. This Package Air Preheater was factory-assembled, and requird only 100 manhours to install.

At B. F. Goodrich Co.'s Shelton Plant

Air Preheater boosts combustion air temperature 345°F... gives 6% more thermal efficiency

"Only a Ljungstrom® Air Preheater, with its continuous regenerative principle, could meet our requirements", says A. G. Sandomirsky, Manager of Engineering at the B. F. Goodrich Company, Shelton, Conn., plant. "We produce foam rubber 24 hours a day, five and six days a week. With an Air Preheater we can meet process steam requirements more economically, and an Air Preheater helped us to justify the installation of high efficiency, high pressure equipment for by-product power generation."

Here's why the Shelton plant meets its requirements best with a Ljungstrom Air Preheater: .

1. Ljungstrom is the most efficient heat exchanger you can buy. The Ljungstrom rotor revolves continuously through the flue gas and incoming air, thus absorbing heat and releasing it *from the same surface*. Since the heat doesn't have to pass through anything, each inch of rotor surface is as efficient as one foot of a tubular recuperator.

2. Ljungstrom is the most reliable heat exchanger you can buy. All heat exchange elements pass through the entire air and gas streams. The temperature of the elements in the coolest region – where fresh air enters – is actually an average of the gas and air temperatures, so it's consistently higher than the coolest point in a recuperative heat exchanger. Result: no cold spots, less chance of moisture formation.

3. Ljungstrom is easiest to maintain. You can inspect it – and clean it–while it's running. Heat exchange elements are divided into modular baskets that can be replaced individually without disturbing the other elements. You can even reverse the elements if the surface has thinned on one edge, effectively doubling the life of the heat exchange surface.

For more information on the Ljungstrom continuous regenerative principle, or on the Air Preheater that meets your requirements, phone MUrray Hill 2-8250 or write to The Air Preheater Corporation.

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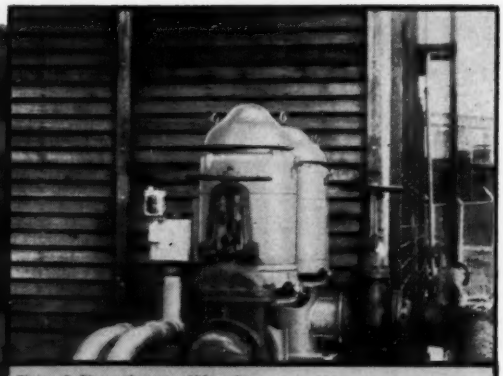

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FRANK T. DROUGHT, Consulting Engineer

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Unfortunately, among our clients there are some irritable and unreasonable persons who indulge in caustic criticisms of our efforts. These must be accepted with patience, and an opportunity must be found to quietly and courteously make a full and satisfactory explanation. Above all, patience and tact must be exercised, and the criticism must be answered.

We have another secondary, but very important purpose – a matter of organization policy. The principal agency using the engineering solutions produced by this organization is the contractor who constructs the job. We will not assume that he is a gambler because of the nature of his business. We will not penalize him by taking advantage of an error he might have made. We will recognize that our engineering ideas may not have been too clearly defined, and we will render him all reasonable and fair assistance in order that he may suffer the least financial loss. We will give him all of the cooperation necessary to enable him to complete the work on schedule in a profitable manner, but without deviation from plans and specifications, unless we and the owner consent.

This organization must maintain a relationship of complete trust and confidence with our clients. Under no circumstances will we permit ourselves to criticize their business or professional abilities, their personal eccentricities, or any of their unreasonable or whimsical demands. The business we transact with them must remain confidential in all respects.

We are not particularly concerned with what our competitors do, unless we can learn from what they do. We are much more concerned with what we do not do. Consequently, if we cannot speak well of our competitors we will not speak. Silence is much more potent and dignified than contemptuous and hollow talk.

This organization will be professional in thought, attitude, and action.

Your Position

As a member of this organization you are accepted in trust. You are one of a group that has a definite and common mission. In order to accomplish this mission, we must work in full cooperation and in a friendly spirit with each other.

The mission should be to serve our clients in accordance with their wishes in order that your personal service may attain the highest degree of acceptance, may establish complete trust and professional confidence, and may build a bond of friendship that will sustain the organization against the solicitations of our competitors. If you cannot do this, you cannot effectively serve the organization regardless of your technical ability or the personal regard of the members of the group for you.

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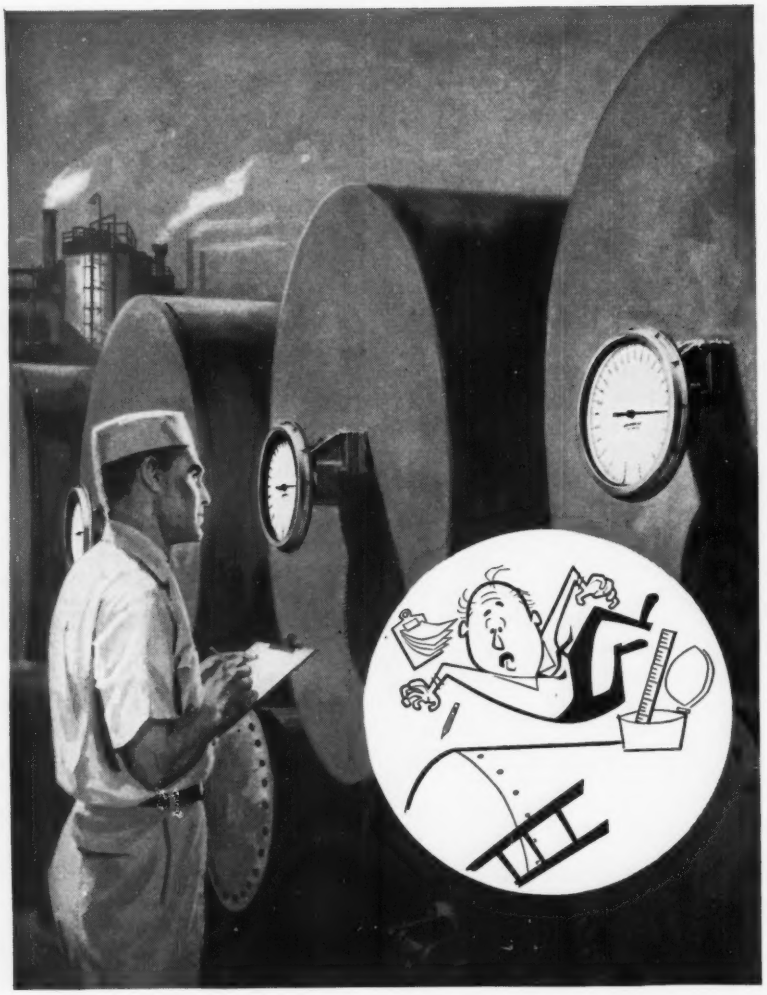

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fidence, giving assistance and encouragement to other members of the group, and devoting all of your working time and energy to the welfare of the group.

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The responsibilities of your position are unbelievably great. An error, even a small one, can involve the loss of life, financial disaster for our client, or bankruptcy for the organization. In this profession there is no court of appeals to rectify an error, nor is there a cemetery in which to bury it. In fact, an error will bury you if it is not discovered in time and instantly corrected, regardless of cost. At whose cost, you might ask? This is a question that has three answers. The owner's – mine – or yours. A careless error, I say, is yours – an unfortunate error, not due to your lack of skill or diligence, would probably be mine – an error of omission from the plans, the cost of which is not included in the contractor's bid, is generally at the owner's expense.

The cardinal and unforgivable professional sin is to conceal an error from your employer. To do this characterizes you as being completely untrustworthy and dangerous. The engineering profession has no place for such a person.

Another delicate matter is that of your separation from this organization. If you are offered what you consider to be a better opportunity or if you must move from this area, I expect you to inform me as far ahead as possible but not less than two weeks in advance. Any vacation time you have coming should not be taken within this two week period. It does not seem very honorable to me to take your vacation and then give me notice. If you give me notice in a proper manner, I will pay you for your vacation time at the end of the notice period.

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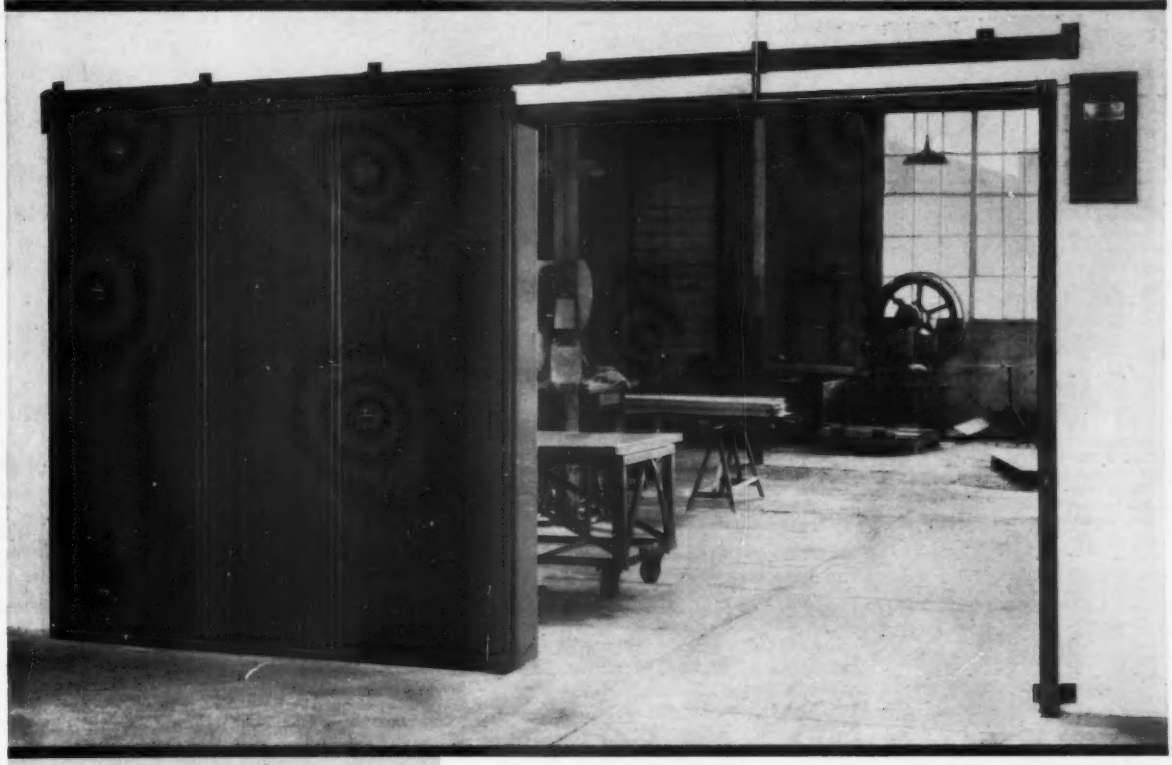

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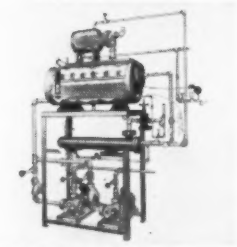

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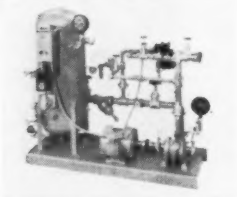

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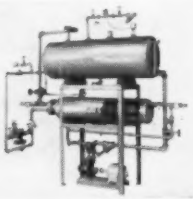

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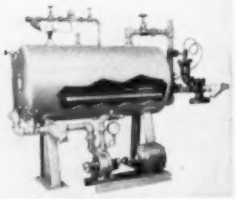

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you will be given two week's pay in advance, regardless of whether or not you have had a vacation.

When a burning ambition to go into business for yourself consumes you, an ethical procedure must be followed to avoid inconvenience to yourself and to retain my friendship and support. It is not only unethical but unlawful to solicit work for yourself while you are being paid by me. Any breach of trust of this nature will bring about an unpleasant and violent reaction from me. You must not take advantage of any trust and confidence or use any information acquired because of your position with me for your own advantage. However, there is nothing wrong with making use of the contacts you have made while in my employ after you have given me proper notice.

These are the primary conditions of your membership in this organization, but there are other things to. These involve the effectiveness of your contribution to the welfare of the group as a whole. The base salaries of the productive members are not nearly the entire cost of the operation. For every dollar spent on income production there is another dollar spent on administrative expense and all of the other non-productive cost, and, of course, profit. It takes two hours of productive work to pay back one hour of idle time. Consequently, if you do not work productively, or if you repeatedly change your mind to indulge your whims, or if you day dream unduly, your contribution is not going to be worth what it costs us.

For all of this responsibility, what is your reward? Your reward will only seem important to you if you are possessed by a consuming need for professional devotion; the desire to serve in a creative capacity the many people who need you. You may also consider it important to have a position with a fine organization, which of course exists only because of the high quality and spirit of its people. ▲▲

ALLIS-CHALMERS

pump precious, toxic, volatile or corrosive liquids without contamination, loss, or danger

LEAKPROOF
electri-CAND
PUMPS

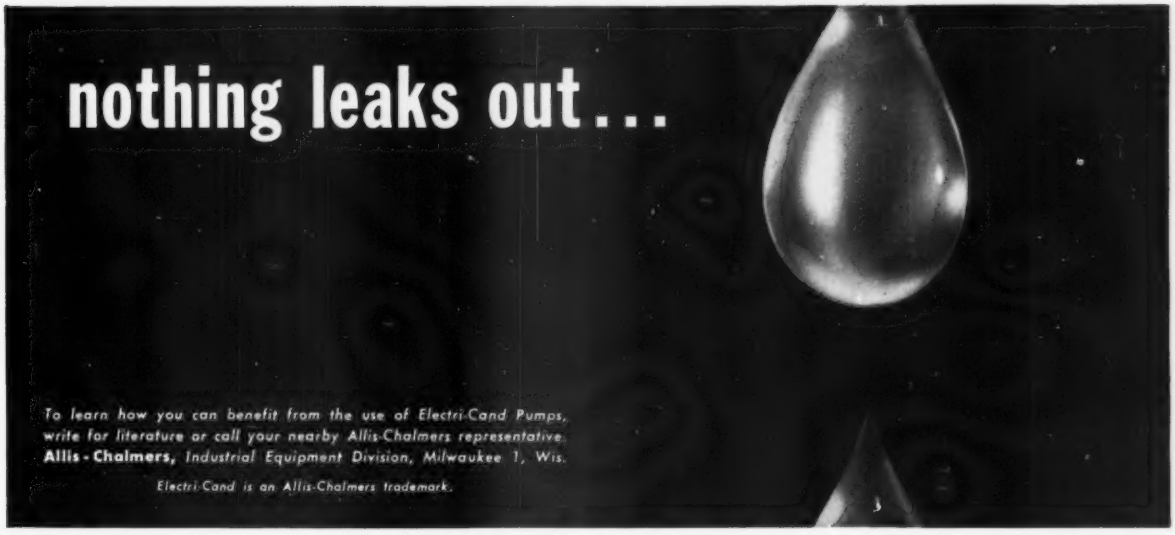
No stuffing box maintenance: *Electric-Cand* pumps handle practically any clear liquid efficiently and safely. Because they are built without packing, stuffing box or seals, the system is air-tight. Contaminants cannot enter, fumes and liquids cannot escape.

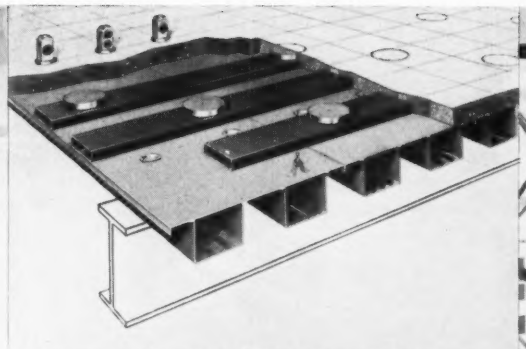
Removable cans: Only Allis-Chalmers pumps feature removable cans. Should stator burn out, replacement can be made using same can. Fewer moving parts are needed. Fewer spare parts are necessary.

Fluid piston bearings: Self-equalizing fluid-piston bearings, which maintain complete hydraulic balance at all times, are available on all sizes, offered only on *Electri-Cand* pumps.

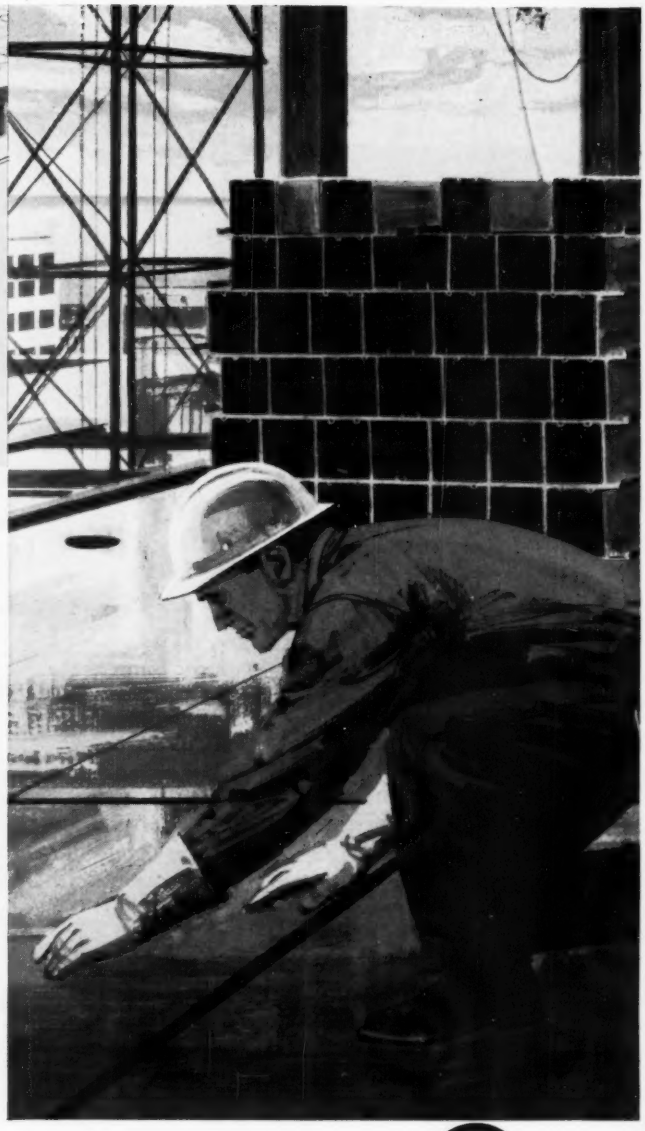
Individually engineered: All *Electri-Cand* units are individually engineered and custom built. As a leading manufacturer of both pumps *and* motors, A-C can assure you complete engineering coordination, resulting in a superior product. Underwriter's Laboratory approval available.

A-1371


nothing leaks out...
To learn how you can benefit from the use of Electri-Cand Pumps, write for literature or call your nearby Allis-Chalmers representative.
Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.
Electri-Cand is an Allis-Chalmers trademark.



Sectional view of typical M-Floor construction: This electrified steel cellular floor, using M2-4.5 sections, is energized from a three-header duct electrical distribution system. M-Floor installation is easy—electrical wiring is quick—future is built-in.



MAHON M-FLOORS

versatile steel
cellular sub-floor
structural sections

mean planned capacity for today— and tomorrow

Steel — *for strength . . . economy . . . versatility*

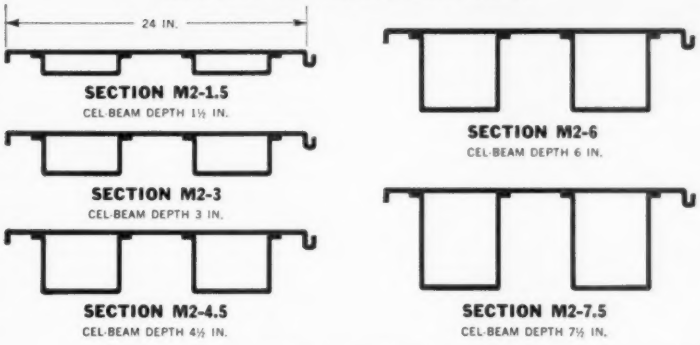
Mahon M-Floors are today's *practical* steel sub-floor system . . . architecturally proven for economy, function, installation ease, and structural advantages. But M-Floors' practicality doesn't stop with installation.

It provides an ideal steel sub-floor with raceway capacity that will not be outmoded by future demands for *additional electrical, communications or data-processing circuits.* Mahon M-Floors in your projects means you have given your clients a capacity they can live with and grow with. Have a Mahon architectural representative explain the *long-range benefits of M-floors.*

THE R. C. MAHON COMPANY · DETROIT 34, MICHIGAN

Manufacturing Plants—Detroit, Michigan and Torrance, California
Sales-Engineering Offices in Detroit, New York, Chicago, Torrance and San Francisco
Representatives in all principal cities.

MAHON M-FLOOR SECTIONS



Note: These M-Floor Sections are also available with cell elements having integral stiffening ribs for improved section properties.

MAHON BUILDING PRODUCTS

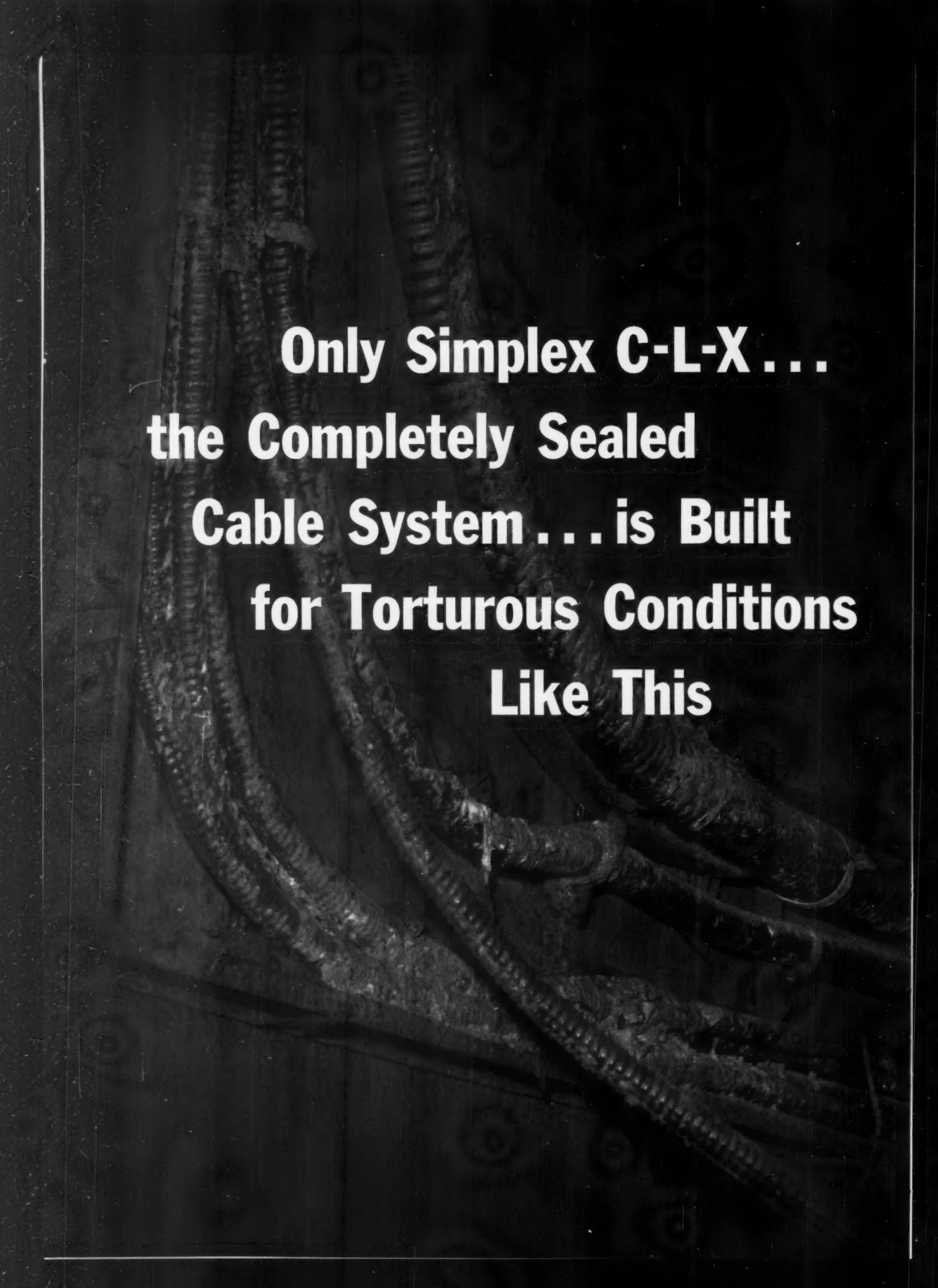
- Aluminum or Steel Curtain Wall (natural or colored metals)
- Rolling Steel Doors (Standard or Underwriters' labeled)
- Metalclad Fire Walls (Underwriters' rated)
- M-Floors (Steel Cellular Sub-Floors)
- Long Span M-Deck (Cellular or Open Beam)
- Steel Roof Deck
- Acoustical and Troffer Forms
- Acoustical Metal Walls, Partitions, and Roof Deck
- Permanent Concrete Floor Forms

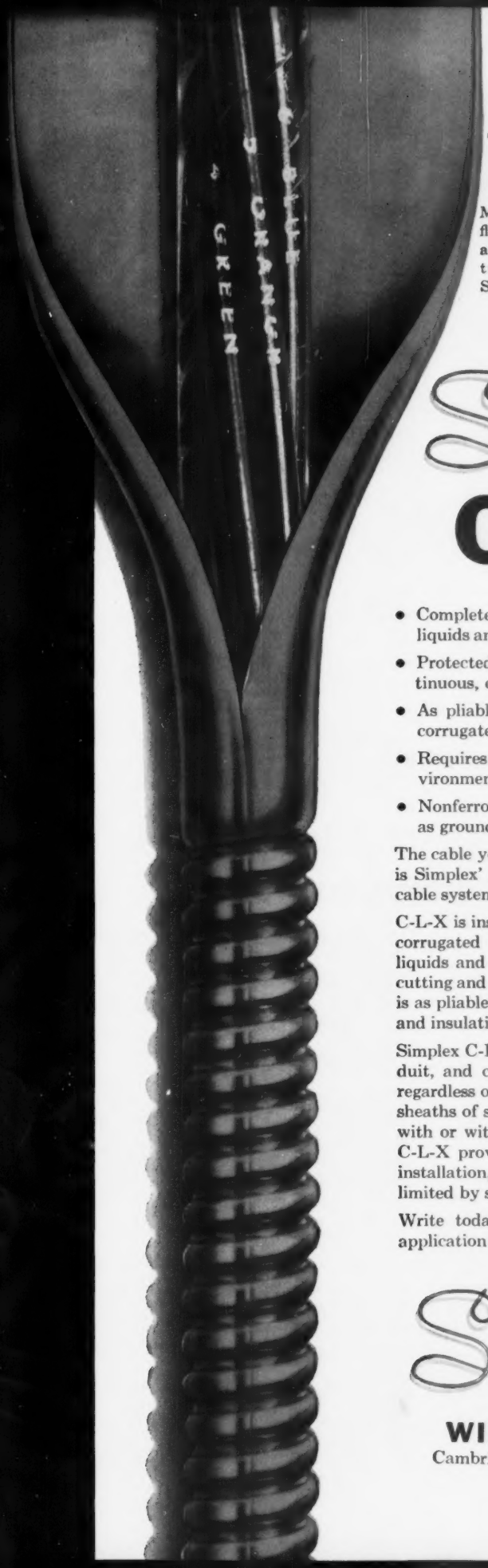
CONSTRUCTION SERVICES

- Structural Steel—Fabrication and Erection
- Steel Fabrication—Weldments
- Geodesic Domes—Fabrication and Erection

SPEEDING AMERICAN CONSTRUCTION WITH METAL BUILDING PRODUCTS, FABRICATED EQUIPMENT AND ERECTION SERVICES

MAHON


Only Simplex C-L-X . . .
the Completely Sealed
Cable System . . . is Built
for Torturous Conditions
Like This



Simplex C-L-X combines cable and duct in one integrated system

Metal, in the form of a continuous flat strip, is formed into a welded tube around the insulated cable. The metal tube is then corrugated to form Simplex C-L-X.

Simplex C-L-X

- Completely sealed to prevent penetration of liquids and gases.
- Protected against mechanical damage by a continuous, corrugated metallic sheath.
- As pliable as unsheathed cable because of its corrugated design.
- Requires no separate duct or conduit in any environment.
- Nonferrous sheaths can be designed to function as grounds or shielding.

The cable you see here is *not* interlocked armor. It is Simplex' new C-L-X . . . the completely sealed cable system.

C-L-X is insulated cable enclosed in a continuous corrugated metallic sheath. It is impervious to liquids and gases, is highly resistant to crushing, cutting and other forms of mechanical damage, and is as pliable as unsheathed cable of the same size and insulating compound.

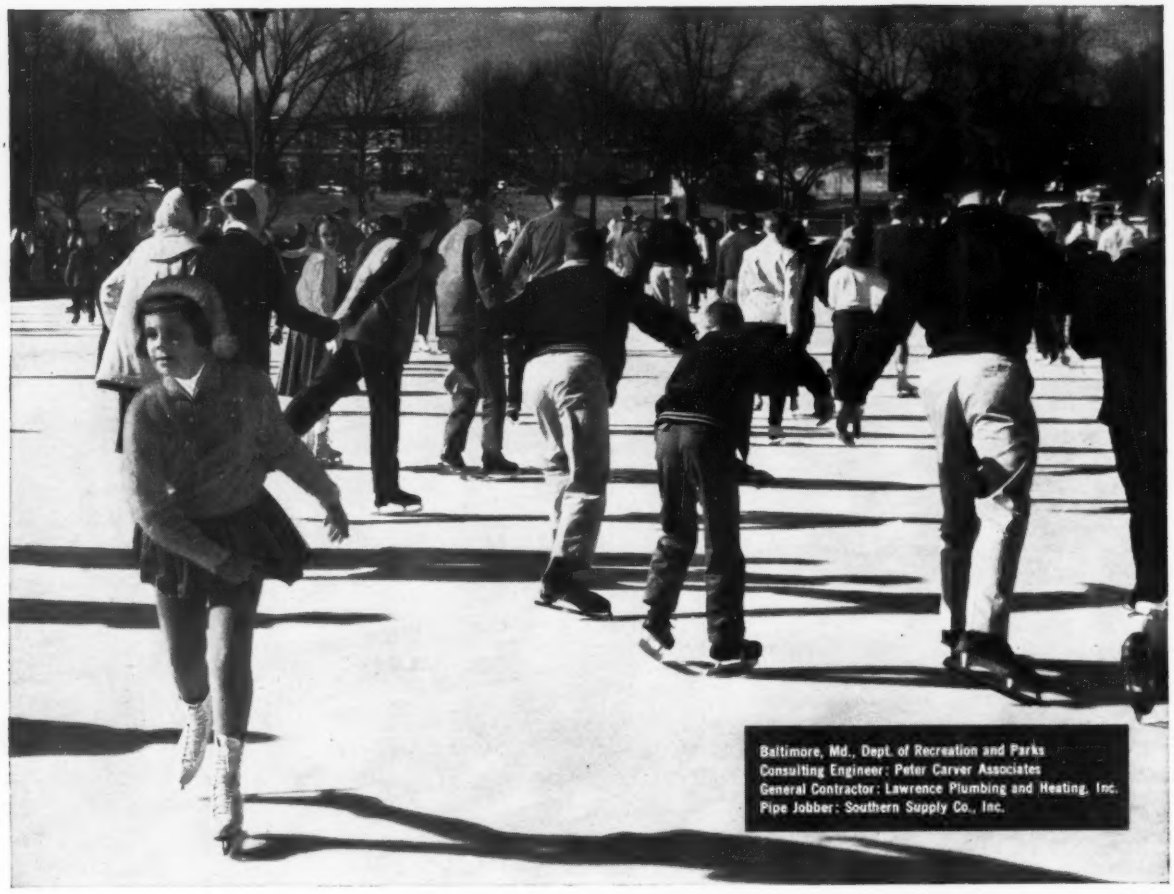
Simplex C-L-X requires no separate duct or conduit, and can be installed in a continuous run regardless of the number of bends. Available with sheaths of steel, aluminum, copper or bronze, and with or without outer plastic jacketing, Simplex C-L-X provides the ideal solution for almost any installation, particularly those in which cable life is limited by severe ambient conditions.

Write today for illustrated brochure containing application and engineering information.

Simplex

WIRE & CABLE CO.

Cambridge, Mass. • Newington, N. H.


Baltimore, Md., Dept. of Recreation and Parks
Consulting Engineer: Peter Carver Associates
General Contractor: Lawrence Plumbing and Heating, Inc.
Pipe Jobber: Southern Supply Co., Inc.

2000 skating enthusiasts or 200 parked cars make no difference with **steel pipe** on the job

Baltimoreans can be proud of their combined ice skating-parking area just outside the new Memorial Stadium. And with reason. In winter they can enjoy ice skating at its best. When crocuses harbinger spring, the rink disappears. In its place, a parking lot serves spectators of the events held in the adjacent stadium.

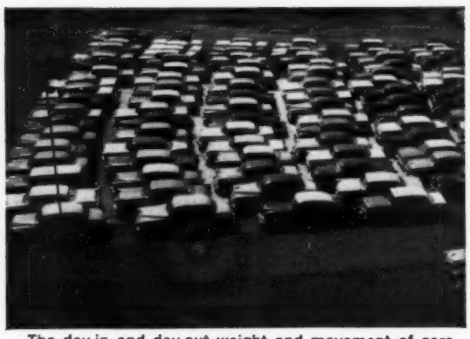
Versatile? Yes. Cost cutting, too—because of *steel pipe*. For *steel pipe* makes possible this dual-purpose area. When it's skating time, a *steel pipe* refrigeration system, imbedded in the 85-foot by 185-foot concrete slab, freezes 1½ inches of water into mirror-smooth ice. Yet, the *steel pipe*, acting as reinforcing in the concrete, has the structural strength to withstand the load of cars parked on the area during the spectator events seasons.

Only *steel pipe* can do this job so dependably, so economically. Its coefficient of expansion during alternate freeze/thaw cycles is comparable to concrete. Its strength, proved joining methods, durability assure virtually maintenance-free service. *Steel pipe* is the proved tubular product for refrigeration, for ice skating rinks, for vent and drainage, plumbing and air conditioning, transmitting gases and liquids. It serves well and long in such varied applications as electrical conduit, protective railing, fire sprinkler systems and other uses.

No wonder *steel pipe* is *first choice*.

COMMITTEE OF STEEL PIPE PRODUCERS

150 East Forty-Second Street, New York 17, New York



The day-in and day-out weight and movement of cars offer no structural problem for steel pipe on this combined skating rink/parking area.

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

Insist on MADE IN USA Steel Pipe

C-4

THE HIGH SPOTS

Heard in Rome

The Italian authorities were hard put to it to get the Olympic Village, arenas, and pools finished in time for the start of the Olympic Games. But they just managed it. Just before the Games began an American tourist, passing the Colosseum, gave it as his flat opinion: "They'll never finish that one on time!"

Old Chicago Water Main

Workmen on a Chicago sewer replacement project recently removed several pieces of a cast iron water main which was laid in 1852. Age of the main was authenticated by its bell construction and side seam closure. The 4-in. pipe, too small for today's needs, is still usable. It was among the first of the nine miles of cast iron pipe laid in 1852 to take the place of wooden pipe then in common use.

According to Chicago Historical Society files, 1852 was the year the Illinois Legislature authorized the city to form the Chicago City Hydraulic Company for the purpose of improving Chicago's water supply and distribution system. The pipe undoubtedly supplied water to the "Wigwam" during the convention nominating Abraham Lincoln for president.

Canadian Consultants Abroad

A Canadian mission of consulting engineers recently traveled to South America to encourage close relations between Canadian and Latin American members of the profession. The mission was timed with the sixth convention of the Union Panamericana de Asociaciones de Ingenieros, which was held from September 18 to the 22. By attending this convention of consulting engineers in Buenos Aires, and then visiting other South American cities, members of the Canadian mission acquired a better knowledge of engineering achievements and problems in Latin America.

The Canadian Minister of Trade and Commerce pointed out that Canada's consulting engineers are particularly well equipped to understand Latin American conditions and requirements. In the large scale development of natural resources in Canada, they have solved problems of a similar nature now facing the South Americans. He pointed out that Canadian consultants would be happy to share with their South American colleagues the engineering skills derived from that experience.

The Passing of the Bonus?

In a recent survey by Industrial Relations News, only 12 of 23 companies reported bonuses of any kind. These fresh findings support an earlier IRN study of Christmas bonus practices. A survey last year indicated that more than 16 percent of U. S. corporations scrapped their 1959 Christmas bonuses.

Blatnik Committee Battles

In spite of a formal report to the Blatnik Committee by the Bureau of Public Roads covering irregularities in the acquisition of highway right-of-way in the State of Massachusetts, there are no further hearings planned until after the November elections. This brought a blast from ranking minority member Gordon H. Scherer (R-Ohio) who accused the Democratic majority of manipulating the Committee investigations for political advantage in this election year. In his opinion, the conduct of the Committee to date has been such that no one will have confidence in its findings, and the public will continue to question its motives.

Solid State Data Processing

Burns and Roe, Inc., New York City consulting firm, has installed a transistorized IBM 1620 data processing system as part of its continuing program to expand and improve engineering services. The new desk-size, solid-state computer will be used in development of the production atomic reactor at Hanford, Washington, and the Project Mercury man-in-space program. In these and other defense, power, and general industry projects in which Burns and Roe plays a leading role, the system offers two major advantages. It will produce substantial savings in calculation time and allow more complex analyses than are feasible manually.

According to Dr. S. Baron, the firm expects to speed the solution of such difficult calculations as shield thickness for atomic reactor design, nuclear physics problems, power plant heat balances, as well as distribution and control of electrical generating station output. Other typical problems will include permissible deviation for radar installations, free-form structural computations, and stress analyses on steel building framework.

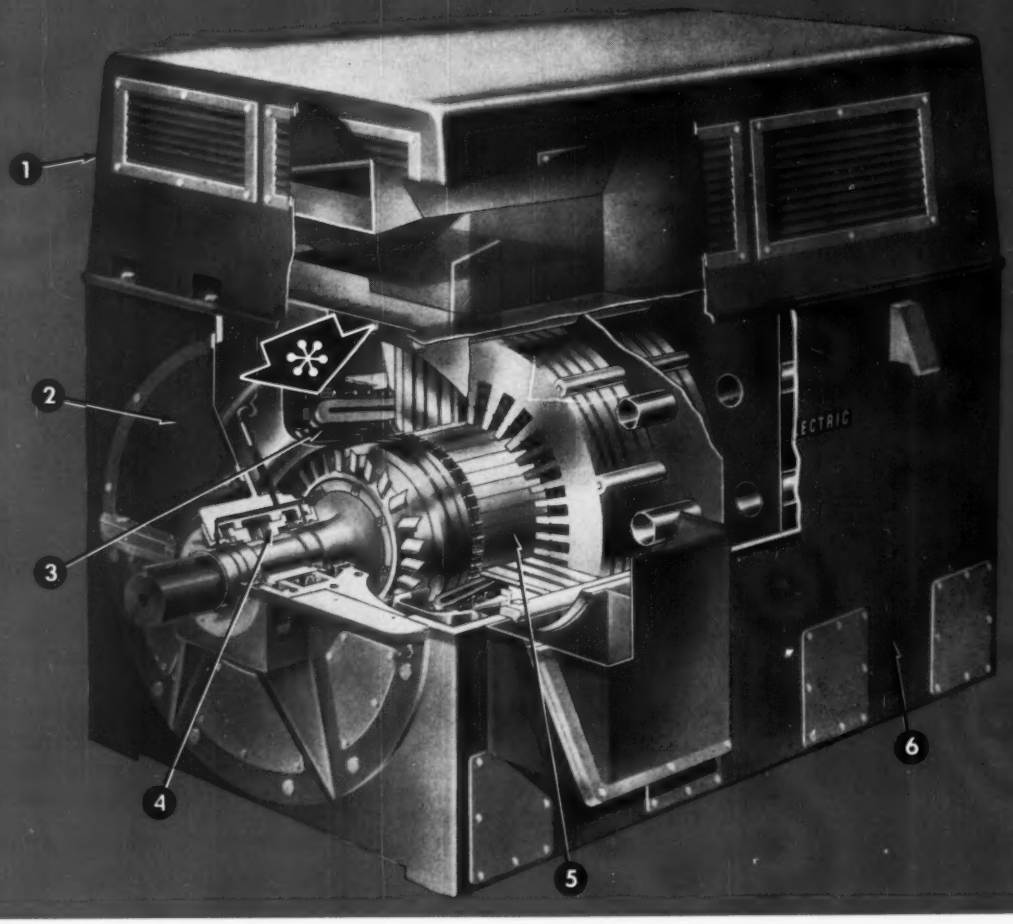
Registration Law in Danger

According to the California Council of Civil Engineers and Land Surveyors, the registration law is in greater danger today than it probably ever has been. The Committee on Engineering Laws has a nationwide movement underway to modify all engineer registration laws so that corporations can build a business around the professional registration of an employee. This same group is reported to have been in action at the National Council of State Boards of Engineering Examiners' meeting in August, when the 1960 Model Law revisions were adopted by a vote of 37½ to 5½.

Meanwhile, a recent attack on licensing boards in the Los Angeles

NEW General Electric CUSTOM '8000' Boiler Feed Pump Motors . . .

CUSTOM DESIGNED FOR POWER STATION APPLICATIONS



1 REMOVABLE "TOP-HAT" provides easy access to motor interior. Top-hat is baffled and lined with sound absorbing materials to attenuate motor operating noise. Rotor and stator are constructed to reduce noise and direct sound waves into the acoustically treated top hat.

2 NEW END SHIELD DESIGN reduces time required for inspection and maintenance. One man can quickly unbolt and lift off the upper end shield half and remove the split air deflector. Bearing support is integrally cast with the lower end shield. Lower half of bearing can be "rolled out" for inspection without removing end shield.

3 EXCLUSIVE POLYSEAL* SUPPORTED SILICONE RUBBER INSULATION SYSTEM provides superior mechanical, thermal, voltage and environmental endurance—affords top reliability in critical Electric Utility applications.

4 TRIPLE PROTECTED BEARING SYSTEM lengthens boiler feed pump motor life. A primary seal is formed by the ring mounted on each end of the bearing shell and adjacent oil slinger machined in the shaft. A multiple groove seal at each end of bearing housing acts as a second line of defense against dirt entrance and oil leakage. In addition to the slingers and close running labyrinth seals, G.E.'s new bearing system utilizes an *Air-Lock* seal in each bearing housing. Air at slightly higher than atmospheric pressure is piped to annular grooves at each end of the bearing. This air pressure acts as a third seal to keep oil locked in the bearing housing.

5 ROTOR PARTS ARE MACHINED TO PRECISION TOLERANCES and assembled using especially developed techniques to assure high-speed operational stability.

6 RUGGED FRAME ASSURES SOLID STRUCTURAL SUPPORT for stator, end shields, rotor and top-hat. Frame is precision machined to positively align motor parts.

GENERAL ELECTRIC'S "CUSTOMIZED" MOTOR manufacturing philosophy permits the design flexibility, and the adherence to quality control production standards, which assure Electric Utilities of optimum motor performance, reduced operating costs and lower first cost. In keeping with requirements of Electric Utilities, Custom '8000' boiler feed pump motors are available now in ratings to 10,000-hp. 883-01

* Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

and San Francisco Examiners is said to be the opening of a drive by the union to seize control of the licensing function of government. Their first step would be to demand lay, i.e., union representation, on every one of the various licensing boards.

Electrical Diagram Standards

American Drafting Standards Manual, Section 15, Electrical Diagrams, Y14.15-1960, has been approved by the American Standards Association, published by the American Society of Mechanical Engineers. This is the first American standard to deal with the actual preparation of electrical diagrams. It includes detailed recommendations on preferred practices to eliminate divergent electrical diagram drafting techniques. The illustrations in the standard represent good drafting practice only, and are not intended to serve as engineering design guides. The new manual is available at $1.50 per copy from the American Standards Association.

Fatigue of Concrete

The American Concrete Institute has just published a bibliography entitled, "Fatigue of Concrete." It lists and annotates 114 significant works published since 1898 on the fatigue of plain and reinforced concrete. No other comprehensive bibliography in this field is available, according to ACI Committee 215, which researched major technical publications of many countries to compile the reference. The 38-page bibliography is in 8½ x 11-in. format, saddle-stitched, and punched for insertion in a three-ring binder. It is priced at $2.50 per copy.

State Highway Engineers

The American Road Builders' Association Sixth Survey of State Highway Engineers Salaries again shows a fairly consistent increase in the state salary structure. It is interesting to note that the impact of the Federal-aid Act of 1956 brought certain organizational changes. Relative positions in the state highway departments have been adjusted to meet the demands placed upon them. The new survey reflects these organizational adjustments.

Highest paid executive or chief administrative officer is in the State of Maryland with an annual salary of $25,000. This tops the chief engineer's annual maximum by almost $8000. In Illinois the chief engineer's maximum salary is $22,800, with the executive or chief administrative officer's at $15,000.

New Business Up in '59

According to a McGraw-Hill survey, the 1805 consultants who took on $100,000 or more in new heavy construction design last year worked on 5543 projects with a total estimated construction cost of $7.83 billion. Dollar volume increased 59 percent over 1958 and the number of projects was up 17 percent, in this particular group.

A big increase in new work came in industrial building. Although sewage engineering volume rose only 10 percent, the $864 million in new projects made up the second largest market for engineering services in 1959.

International Bridge Financing

Arrangements for financing a $20 million international toll bridge, linking the United States and Canada at Sault Ste. Marie, were completed in Lansing, Michigan. Announcement was made of the sale of $16,250,000 in bonds – $7,850,000 taken up by the Ontario government and $8.4 million underwritten by six United States investment banking firms. Another $3,750,000 will come from the U. S. Bureau of Public Roads and the State of Michigan.

Negotiations are under way on the Ontario "Soo" for bridge approaches. Acquisition of property on the United States side is being handled by the Michigan Highway Department. Construction of the

NEW

encapsulated connection harness increases mechanical strength, assures maximum motor reliability

General Electric's new encapsulated connection harness consists of two rings of insulated conductors encapsulated in epoxy resins. The larger ring contains motor leads and phase connections, while the smaller ring contains equalizer connections.

This new system provides greater strength and rigidity at the end turns and assures uniform coil connections. Rigid encapsulation prevents contact between conductors—eliminates insulation abrasion. The epoxy compound provides additional insulation for leads and connections.

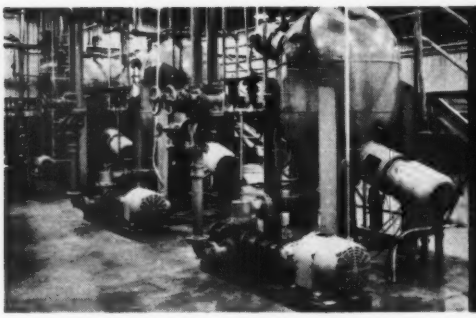
NEW ENCAPSULATED CONNECTION HARNESS for General Electric boiler feed pump motors provides an immobilized connection bundle . . . eliminates loose ties and abraided insulation.

YOUR GENERAL ELECTRIC APPARATUS SALES REPRESENTATIVE has full details on new G-E boiler feed pump motors. Call him today. Medium AC Motor & Generator Department, Schenectady 5, N.Y.

Progress Is Our Most Important Product

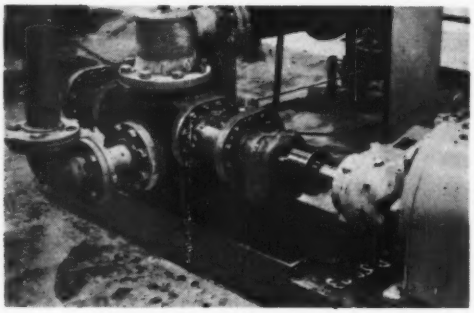
GENERAL ELECTRIC

For High-Viscosity Pumping--



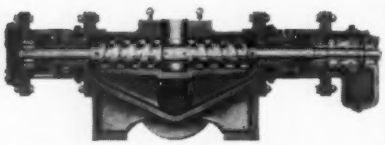
specify
Sier-Bath SCREW PUMPS

SHUFORD MILLS pumps rubber-resin adhesives of 700,000 SSU at 140°F.

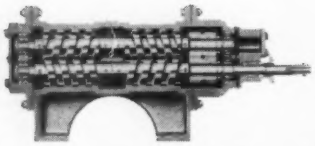


• At Shuford Mills, manufacturers of pressure sensitive tapes, 5 Sier-Bath Pumps transfer heavy liquid adhesive from mixing tanks to storage tanks. These mixtures, consisting of toluene, MEK, natural rubber, synthetic rubber, resin and additives, have been pumped by Sier-Bath Screw Pumps with good success since 1955. All gears and bearings are externally mounted to avoid contact with materials pumped. A Sier-Bath Hydrex Pump is also used to pump varnish and a Sier-Bath Gearex Pump handles toluene and MEK solvents.

Sier-Bath SCREW PUMPS



External Gear and Bearing Bracket Type for non-lubricating liquids and semi-liquids



Internal Gear and Bearing Type for lubricating liquids and semi-liquids

Sier-Bath Screw Pumps maintain high volumetric efficiency because "Dual-Controlled" precision rotor design prevents rotor-to-rotor or rotor-to-casing contact—provides a continuous flow without pulsation, hammering or vibration . . . without strains, misalignment and wear on rotors, shafts, bearings and gears.

Result: Dependable, uninterrupted pumping service—less maintenance—easier servicing—longer pump life—lower overall pumping costs.

Capacities from 1 to 2,000 gpm.; viscosities from 32 SSU to 1,000,000 SSU.; discharge to 1,000 psi. for viscous liquids, 200 psi. for water and light oils. Horizontal or vertical construction. Corrosion resistant alloys, special bodies, stuffing boxes and bearings for special needs. See "Yellow Pages" for your Sier-Bath representative or write Sier-Bath Gear & Pump Co., Inc., 9257 Hudson Blvd., North Bergen, N. J.

Sier-Bath ROTARY PUMPS

Screw Pumps | Gearex® Pumps | Hydrex® Pumps

Founded 1905 | Mfrs. of Precision Gears, Rotary Pumps, Flexible Gear Couplings | Member A.G.M.A.

2½-mile long bridge is scheduled to start September 15. Opening is planned for 1962.

Los Angeles Transit Authority

C. M. Gilliss, executive director of the Los Angeles Metropolitan Transit Authority, has been authorized to negotiate with the New York consulting firm of Coverdale & Colpitts to conduct a preliminary study of the transit system proposed recently by the Los Angeles engineering firm of Daniel, Mann, Johnson & Mendenhall. The Authority has authorized a maximum expenditure of $25,000 for a preliminary survey of the economic feasibility of the proposed $529 million rapid transit system.

Turnpike Medial Barriers

The consulting engineering firm of Michael Baker Jr. told a special meeting of the Pennsylvania Turnpike Commission that 90 miles of medial rail should be built without question, and another 180 miles could have guard rails. At present there are 47 miles of medial rail on the 370-mile east-west road. The northeast extension to Scranton carries a 14-in. concrete medial barrier.

While aware that some engineers do not favor rails because they might deflect cars back into fast-moving traffic, causing multi-vehicle accidents in the same lane, the Turnpike Commission Chairman, Joseph J. Lawler, said that there is a unanimous public demand for the rails. It was estimated that the entire project will cost almost $8 million.

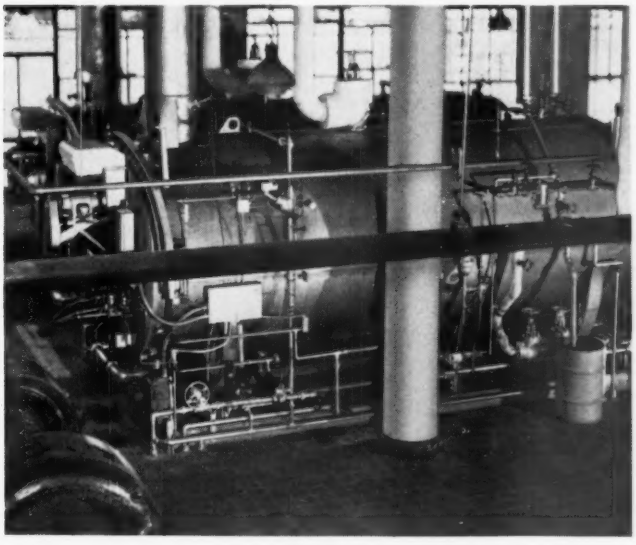
Community Development Contest

Hueston M. Smith, president of Consulting Engineers Council, and Alger Malo, president-elect of the Institute of Traffic Engineers, were called on recently by the U. S. Junior Chamber of Commerce to help judge the U. S. Jaycees' 1959-60 Community Development Contest. The panel picked three winners from 33 state entries in the national contest. They were the Jay-

can you afford to recommend a boiler designed 20 years ago?

BOILER ROOM CONVERTED TO WORK AREA

Robert A. Johnston Company, cookie, candy and chocolate products manufacturer in Milwaukee, Wisconsin, replaced four coal-fired boilers with two fully automatic, gas-fired CB boilers. Mr. James Vida, plant engineer, reports: "Compact Cleaver-Brooks design made it possible for us to install the boilers in another part of the plant — in an area of only 750 sq. ft. — releasing the old boiler room, 9000 sq. ft., for storage and work areas. It saved us the cost of an expansion project."



Today, with building costs twice what they were in 1945, your clients can't afford big boilers and the space to house them. They probably need greater boiler capacity, but they need extra space even more. The problem is to satisfy both needs.

To keep pace with climbing construction costs and the compact requirements of modern architecture, one manufacturer, Cleaver-Brooks, has proved that big boiler performance and capacity can be engineered into a small boiler package. Today's CB packaged boilers help solve many unusual installation problems. Low headroom is one example. Shortage of ground-level space is another; clean-cut, compact design cuts the space used, releases it for production or storage purposes. In some cases, "penthouse" installations have utilized space on an upper floor and *completely eliminated* the use of ground-level space.

Here are some of the features that combine for maximum space saving: four-pass design, forced-draft combustion, updraft construction and all the advantages of five square feet of heat-transfer surface per boiler horsepower. These standards of quality and compactness are only available from Cleaver-Brooks, manufacturers of the most compact, fuel-saving packaged unit on the market.

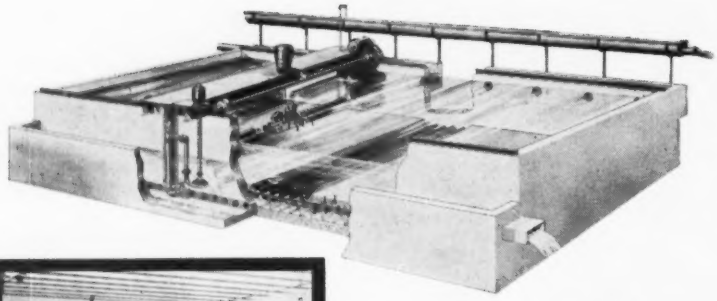
Cleaver-Brooks boilers are completely pre-engineered and tested as a package . . . expertly started by a trained field engineer. Sizes through 600 hp . . . oil, gas and combination oil-gas firing . . larger sizes in Cleaver-Brooks Springfield water-tube boilers.

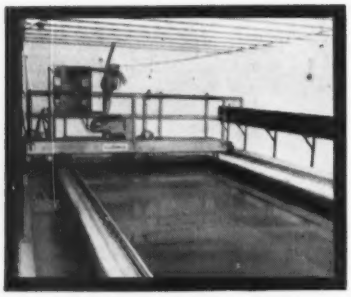
See your local Cleaver-Brooks agent or write for a set of boiler-room templates designed for consulting engineers.

Cleaver Brooks®

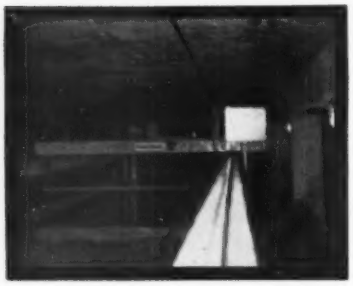
ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

CLEAVER-BROOKS COMPANY
Dept. L, 321 E. Keefe Ave., Milwaukee 12, Wisconsin





12½′ x 40′ Hardinge Automatic Backwash Sand Filter in a municipal water plant in Vermont.



12½′ x 86′ Hardinge Filter handling water supply for a Canadian paper plant.

A sand filter for

CONTINUOUS

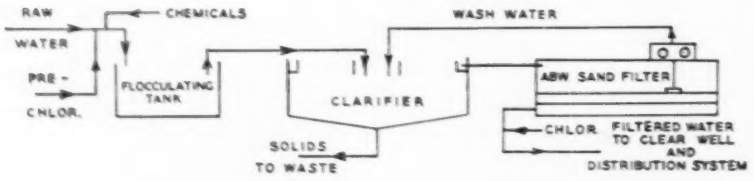
Water Supply

The Hardinge Automatic Backwash Sand Filter is a complete departure from standard filtration equipment, in that it backwashes its filter bed automatically without interrupting normal filtration.

The ABW filter in combination with flocculation and sedimentation equipment provides an uninterrupted supply of treated and filtered water for municipal and industrial use.

The filter may be applied also for the treating of plant waste water, for reuse or disposal.

Complete specifications upon request. Bulletin 46-A-64.



The flow sheet above illustrates the use of a Hardinge ABW Filter, in conjunction with Hardinge flocculating and clarifying equipment, on municipal or industrial water treatment. A modified system is available for liquid waste disposal or reclamation.

HARDINGE

COMPANY, INCORPORATED

Main Office and Works • 240 Arch St., York, Pa.

"Hardinge Equipment—Built Better to Last Longer."

NEW YORK
TORONTO
CHICAGO
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SALT LAKE CITY
SAN FRANCISCO
HOUSTON
LAKELAND
BIRMINGHAM

cee chapters at Downers Grove, Illinois, first place; Enfield, Connecticut, second place; and Chattanooga, Tennessee, third place.

Newspaper Contest Continued

The Consulting Engineers Association of Oregon will again sponsor its Newspaper Citizen Leadership Awards competition because interest by the press has been exceptionally high. The association awards a $250 cash honorarium and three bronze commendation plaques to the three newspapers which, in the opinion of the judges, contributes the most to awakening citizens to the need for specific community improvement and aiding in its accomplishment.

Eligible are reporters, writers, photographers, and editors and publishers of all the state's weekly and daily newspapers except the dailies of metropolitan Portland.

Last year the Corvallis *Gazette-Times* took first place with its campaign in behalf of water system bonds, and retiring president Guy H. Taylor presented the award to Mike Bradley, *Gazette-Times* news editor at the annual meeting at Gearhart. *The Times* of Rogue River was second for its part in support of a new school and the *Eugene Register-Guard* was third for working toward an expanded power supply.

Engineer-Scientist Demand

To meet the need for an objective measure of the demand for technical and professional manpower, Deutsch & Shea, Inc., technical manpower consultants, has developed the Engineer/Scientist Demand Index. The Index is based on monthly measurement of the recruitment advertising directed to engineers and scientists appearing in a carefully selected group of technical journals and the leading newspapers in 20 key market areas.

The first quarter of 1960 showed the most pronounced recruiting activity. In the second quarter this activity slackened perceptibly.

NO SERVICE PROBLEM HERE...

Exclusive with UNIVERSAL *"Service Guaranteed"* BALLASTS

For years, UNIVERSAL has been paying the bill for the replacement of in-warranty inoperative fluorescent ballasts. These payments are a direct part of the *exclusive* and *comprehensive* UNIVERSAL Two Year Warranty Service Program with (T)(E)(S)* Architects, engineers, contractors, distributors, fixture manufacturers and maintenance personnel are *all* relieved of the burden of service.

Should you be confronted with a lighting failure which appears to be abnormal, regardless of the number of ballasts involved, you are requested to telephone UNIVERSAL — COLLECT — and ask for (T)(E)(S)* *Within 24 hours* of your phone call, one of our field engineers will visit your installation. Assuming that our technical people determine that the lighting failure stems from ballasts which are being used in proper application, UNIVERSAL will arrange for the replacement of those ballasts and pay all charges in connection with the replacements, *including labor*. This is made possible by the high quality performance of UNIVERSAL "Service Guaranteed" BALLASTS in millions of fluorescent fixtures everywhere. *A fine product can afford a fine guarantee.*

You owe it to your own peace of mind to get the full details on this program. MAIL THIS COUPON FOR DESCRIPTIVE BROCHURE.

**Technical Engineering Service*

The only complete service program in the ballast industry!

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MANUFACTURING CORPORATION
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THE LARGEST INDEPENDENT MANUFACTURER OF FLUORESCENT TRANSFORMERS IN THE UNITED STATES

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Please send me your brochure describing UNIVERSAL's EXCLUSIVE (T)(E)(S) (Technical Engineering Service) PROGRAM.

NAME .....
FIRM .....
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CITY & STATE .....

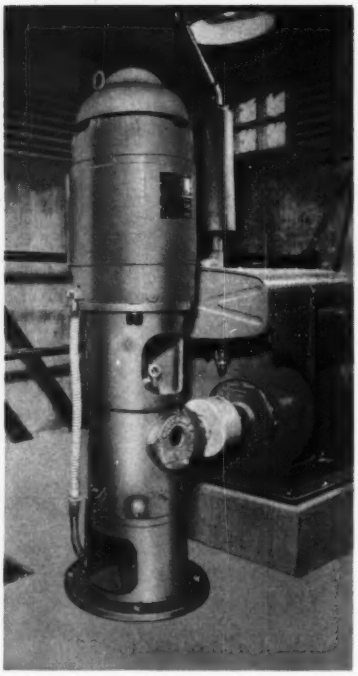
☐ Architect ☐ Distributor ☐ Maintenance Man
☐ Engineer ☐ Fixture Mfr. ☐ Builder
☐ Contractor ☐ Equipment Mfr. ☐ Other .....

For positive protection
against power failures, install

JOHNSON

Right angle

GEAR DRIVES



Cross State Development Co. installed the Johnson combination drive shown here in a sewage disposal plant in Florida. They report: "It's recognized as one of most efficient, packaged systems in the Tampa area. We've never experienced any difficulty." Neither will you because Johnson combination drive assures engine take-over the instant electricity fails. Either power unit may be overhauled without interrupting service.

Sizes: 15 to 450 hp. Johnson Right Angle Gear Drives are available in combination, dual and standard types; for all horizontal prime movers; hollow or solid shaft. Please write for engineering catalogs.

MEMBER OF AGMA

JOHNSON • MAKERS OF FINE GEARS SINCE 1904

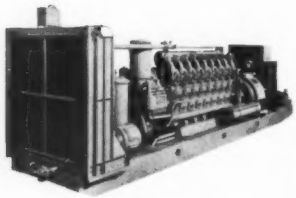
7-R

GEAR & MANUFACTURING CO., LTD.

8TH AND PARKER STREETS • BERKELEY 10, CALIFORNIA

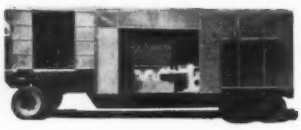
East and Gulf Coast representatives:
Smith Meeker Engineering Co., 157 Chambers St., New York City

DIESEL POWER that's ECONOMICAL!



Portable and Rental Units

Diesel engine generator sets from 100 to 1100 kw, 125 to 1375 kva, completely portable, easily transported, quickly installed, designed for parallel operation, 60 or 50 cycles. A "Central Station" in itself, independent, self-contained.



Also available NOW...

Our giant 300 kw mobile power trailer unit, mounted and ready to roll, a complete plant ready for immediate operation on arrival at your plant project or town, 375 kva, any standard voltage, 3 phase, 60 cycle, suitable for parallel operation.

We stress fast delivery and service . . . since 1898!

A·G·SCHOONMAKER COMPANY, INC.

ESTABLISHED 1898

WEST COAST: Dept. G, Foot of Spring St., Sausalito, Calif., ED 2-1490
EAST COAST: Dept. G, 50 Church Street, New York 7, N.Y. DI 9-4350

These appear to be cyclic variations which reflect the general tendency to change jobs after the Christmas holidays, and to postpone job changes during the vacation months. Over the course of several years it is expected that the Engineer/Scientist Demand Index will provide clear statistical evidence of such trends. In addition, the Index will provide year-by-year comparison of the demand for technical people as evidenced by the sampling of corporate recruitment advertising.

Admixture Symposium Papers

Copies of the book *Effect of Water-Reducing Admixtures and Set-Retarding Admixtures on Properties of Concrete* may be obtained from the American Society of Testing Materials headquarters at 1916 Race Street, Philadelphia, Pa. Price is $7.50 per copy. The book consists of 10 papers and a summary as delivered at a recent symposium sponsored by ASTM.

Four of the papers included represent the joint contribution of four principal producers of admixtures. The remaining papers were prepared by representatives of consumer interests, research organizations, and the cement industry. Extensive tabular material, charts, and references are included in the volume.

Consultants Required

Air pollution control is a specialized field requiring the services of consulting engineers to handle industrial problems, according to Paul A. Arnold, resident manager of the U. S. Pipe & Foundry Company plant in the San Francisco Bay area. In fact, Arnold has already retained Thomas L. Harsell, of Harsell Engineering Company, in Inglewood, California, to help his plant comply with the Bay Area Air Pollution District's regulation No. 2 which goes into effect on January 1, 1961.

Arnold stated that, "Even though our company is a multi-plant op-

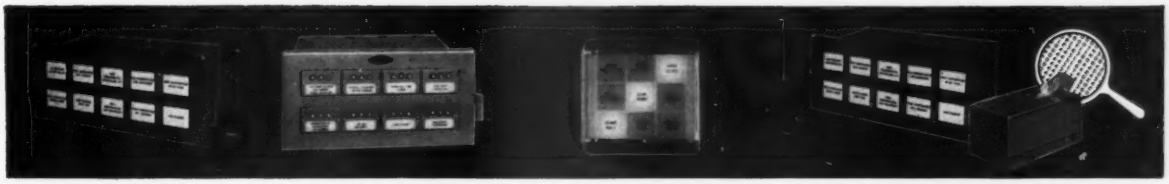
CHOOSE FROM THE

world's largest industrial annunciator line

AS VERSATILE AS YOUR REQUIREMENT

Lessens downtime by giving *instant visual* AND *audible alarms* when an "off-normal" occurs in your process. Time-saving—pinpoints trouble, permits faster correction and resumption of full production.

- Easily expandable universal system—rugged functional construction.
- Variety of sequences—interchangeable plug-in modules.
- Lowest installation cost—trouble-free operation.
- Over 1,000,000 service-proven hermetically-sealed Panalarm plug-in relays in use.



Universal All-Purpose Annunciator System—can continuously monitor all points in your process. Wide choice of visual and audible sequences (optional flashing, ringback, multi-color visual, momentary lock-in, lamp reset, etc.) permits differentiation between new and previously acknowledged alarms.

Digital Sequential Annunciator. Sequentially identifies your required off-normal points instantly. Handles any number of total alarm points. Clear binary readout. Millisecond resolution between points.

Miniature Solid State Annunciator—economical, lo-drain, intrinsically safe, no moving parts. Engineered for mounting in most standard miniature instrument cases. Compatible with high speed compact computer applications.

Recording Annunciator has both flashing visual and audible alarm simultaneous with exclusive digital alpha-numerical recording of operations. No time-wasting decoding, no useless blank tape accumulation. Automatic, permanent, unalterable statistical record saves operator's time, reduces chance of operator error, permits closer supervision. Equally effective in manned or unmanned locations.

All annunciators available in a considerable variety of standard sizes, cabinets and sequences to economically fit your exact requirement. Write today for descriptive catalog which also details Panalarm's unique quality features.

Panalarm manufactures the most complete line of annunciators for information and control. For an optimum competitively priced Annunciator System for your client's plant, consult Panellit engineers. Sales and engineering offices in all principal cities.

PANELLIT A DIVISION OF **ISI** INCORPORATED

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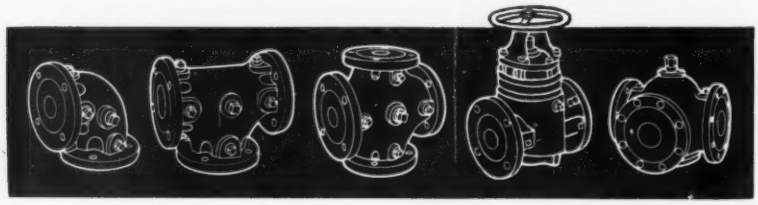
Annunciators • Control Panels • Data Systems • Contract Maintenance and Installation

H&B JACKETED PIPE and FITTINGS

● The above cutaway illustrates H & B standard jacketed welded pipe and fitting construction, designed to allow complete jacketing of the product pipe. Special jigs and fixtures enable H & B to insure complete uniformity of the jacket area in relation to the O D of the product line and the I D of the jacket pipe. All H & B jacketed equipment is hydrostatically tested at 450 to 500 p.s.i. H & B welded steel jacketed fittings are ideally suited for process piping of pressures reaching 300 p.s.i. and temperatures up to 750°F. . . . A few of these fittings and valves are illustrated below. For more information send for bulletin J-57.

HETHERINGTON & BERNER INC. • 747 KENTUCKY AVE., INDIANAPOLIS 7, IND.



NEW Pratt CYCLONE STRAINER
Eliminates Manual Cleaning
Costs Less to Install

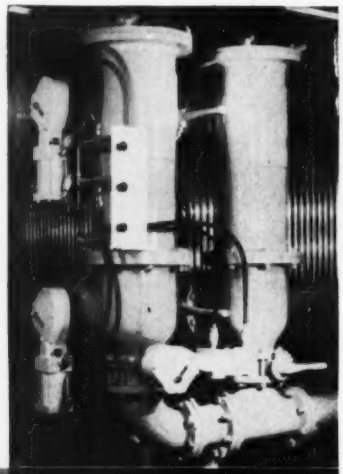
The new Pratt Cyclone Strainer eliminates the manual cleaning usually associated with this type of equipment. Both cleaning and backwashing operations are completely automatic and can be accomplished in seconds.

Unique design simplifies piping, saves space and installs for far less than ordinary designs.

Patented "Cyclone" action keeps larger particles away from basket—keeps strainer "on the line" longer.

Features rubber seat butterfly valves for longer life and positive action. Manual or automatic valve operators.

Write for details.



HENRY PRATT COMPANY
319 W. Van Buren St., Chicago 7, Ill.
Representatives in Principal Cities

HENRY PRATT®

eration, we have decided to seek the aid of a consultant who is specialized and experienced in this particular field. We feel this is a highly specialized field, and although we have been following the subject and studying our operations very closely since 1954, it is our opinion that the quickest and cheapest way to comply with the new regulation is to seek expert assistance."

Arnold's remarks carry considerable weight in the area because he is chairman of the inter-association industry committee of the Alameda County Industries, Inc., which fought industry's battle in the formulation of the new regulation. In that capacity he is influential in the policy decisions of individual companies.

Seattle Sewage Facilities

Metropolitan Engineers, a joint venture of Brown and Caldwell, San Francisco; and Hill and Ingman, Carey and Kramer, and R. W. Beck and Associates, Seattle; has presented its design report on first stage construction of a comprehensive sewage plan for metropolitan Seattle. Including engineering, the cost of the facilities to be constructed initially is estimated to be over $100 million. The improvements will be financed by revenue bonds supported by sewer service charges of $2.00 per month for each residential and equivalent residential customer.

Zetlin Dome on Israeli Stamp

An Israeli stamp commemorating the inauguration of its nuclear reactor has just been issued. It features a drawing of the swimming pool type reactor dome which was designed by Lev Zetlin, New York consulting engineer. The structure was described in the December 1959 issue of CONSULTING ENGINEER.

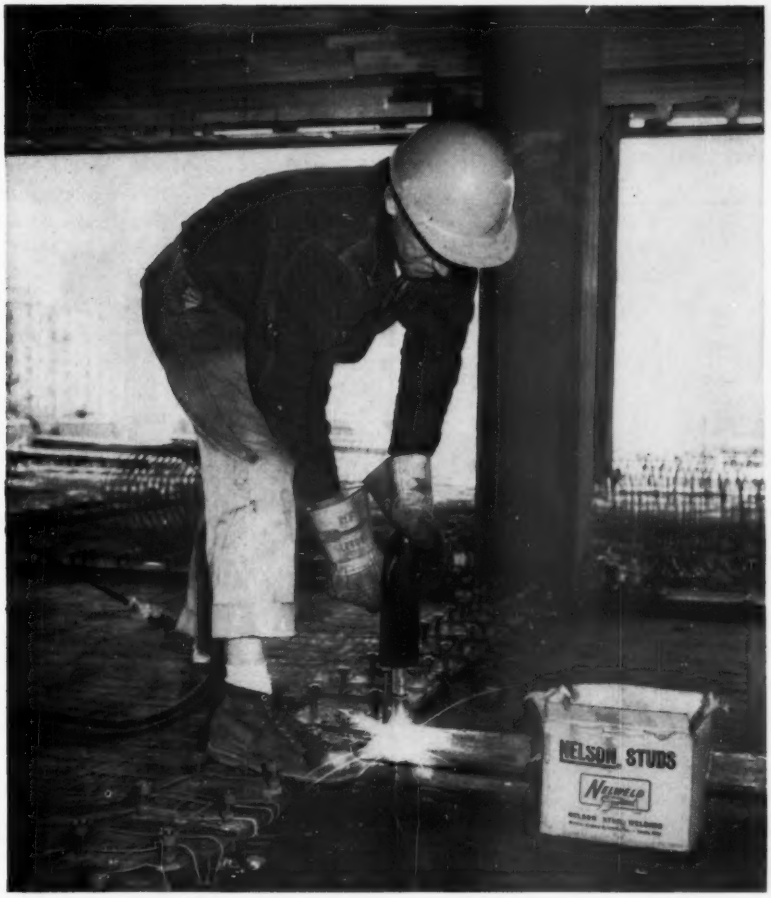
New Structural Steel

Average savings of four to six percent in the weight of steel structures are promised by a new and

JOB REPORT: *NELSON Stud Shear Connectors in Composite Construction*

DOUBLED LOAD CAPACITY

...*after* steel framework is completed



Two rows of 2"-high Nelson Studs *were installed on varying centers to achieve composite action while providing greater flexibility of design, better concrete compaction and lower over-all cost. Nuts were run down on the threaded studs to provide optimum hold-down.*

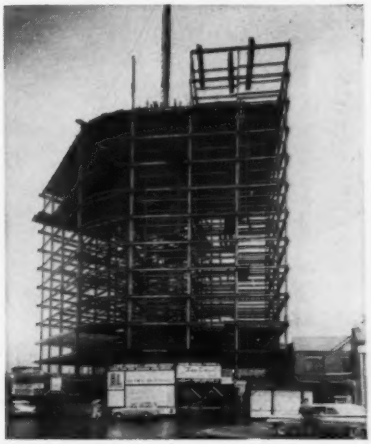
Composite Steel-Concrete Construction Boosts Live Load Capacity from 50 to 100 lbs. psf

Composite construction was employed to double the loading capacity of the second and third floors of the new 13-story Mid-City Center... *after the structural steel framework for the first nine stories had been completed.*

This Forest Hills, N.Y. office building is, perhaps, the first to use composite design to increase the capacity of existing building construction. The leasing of five floors, or 40% of all the buildings office space, hinged on the owners' ability to meet the prospective tenants' requirement for doubled live load capacity to accommodate large electronic and other automated office equipment.

The approach of adding top and bottom cover plates to the standard short span construction was not feasible since the formwork had already been placed. Structural engineers, Abrahams, Hertzberg and Cantor, turned to economical composite construction, using stud shear connectors.

Other advantages and economies can be gained through composite design. For full information, call in your local Nelson Man, or write for "The Case For Composite Construction", Nelson Stud Welding, Division of GREGORY INDUSTRIES, INC., Dept. 14, Lorain, Ohio.



Mid-City Center office building, Forest Hills, N.Y. Architect: Jack Brown • **Structural Engineers:** Abrahams, Hertzberg and Cantor • **Chief Construction Engineer:** Murray Puchall of the Lefrak Organization (owners) • **Structural Steel Fabricators:** Holland Steel Co. • **Steel Erectors:** Atlas Erectors.

NELSON Stud Shear Connectors *are approved by the AASHO for bridge construction.*

For BETTER construction...

NELSON STUD WELDING

DIVISION OF GREGORY INDUSTRIES, INC.

Manufacturers of...NELSON STUD WELDING PRODUCTS • NELSON BULLDOG CONCRETE FASTENING PRODUCTS • NELSON POWDER-ACTUATED FASTENING TOOLS

higher yield point structural carbon steel — A36-60T — according to United States Steel Corporation. Compared to A7 and A373 steels, the new A36 structural steel has a minimum yield point of about 36,000 psi. Available forms of the new steel include structural shapes, plates, and bars.

U. S. Steel stated that its prices for A36 steel are .05¢ per pound higher than for A7 for all structural shapes and for plates up to ¾ inches in thickness. This represents the bulk of steel used in construction. The A36 price difference over A7 is greater for plates and bars over ¾ inches because of the additional chemical requirements necessary to produce these thicknesses. For bars up to ¾ inches in thickness, the price is the same as for A7. The cost to strength ratio of the new steel is substantially better than for existing carbon structural steel specifications and cost savings should result for the majority of fabricated and erected structures.

Neoprene Expansion Joint

A new type of expansion joint which can absorb the movement of concrete during extreme temperature changes without bulge, dip, or gap is now being used on many highways, bridges, and airfield runways. Constructed of neoprene synthetic rubber and steel, the joints have withstood incessant pounding by automobiles and trucks while maintaining a tight seal against water and dirt.

The joint is designed so that the movement of concrete pushes together the neoprene cells or pulls them back to their original position like an accordion. Steel truss rods looping out from both sides anchor it securely to the end of each of the concrete panels. Because it is anchored in this manner, the surface stays flush with the top of the concrete.

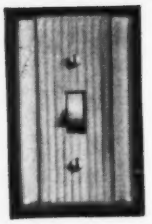
Pipe Specs Stay Open

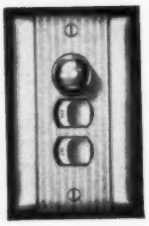
A ruling by the Wisconsin Supreme Court held unconstitutional and monopolistic a rule adopted by the Milwaukee City and Metropolitan Sewerage commissions requiring cast iron pipe for house sewer laterals. Five manufacturers of bituminous fiber pipe had challenged the validity of the rule, adopted in 1958 by the two agencies. The high tribunal's decision will affect millions of dollars in sales of fiber, clay, concrete, and other types of sewer pipe used in home construction in Milwaukee and the Metropolitan Sewer District area.

The high court said that if the rule had contained a method for granting exceptions to the use of cast iron pipe, it would have been held valid. The sewerage commissions contended that the rule was adopted to comply with rulings of the Wisconsin State Board of Health and the board's Committee on Water Pollution. ▲▲

Built to take it... Indefinitely!

THE NEW ROCKER-GLO P&S SWITCH





Here is a switch that can take it . . . and come back for more. Install Rocker-Glo in the most used and abused stations in institutional, commercial or factory building. Then watch its continuous, perfect, satin-smooth performance.

P&S Rocker-Glo switches are AC switches, designed to be used at full current ratings on tungsten filament and fluorescent loads – one does the work of two AC-DC switches for controlling fluorescent fixtures. Rocker-Glo can be used anywhere old-style toggle switches are used.

Rocker-Glo is sturdily constructed. Its rugged, wall-hugging luminous rocker is not subject to breakage from accidental blows as is the case with ordinary switch handles. It's built to withstand punishment ordinary toggle or specialty switches cannot take – changes no wiring habits. Single Pole and Double Pole switches are indicating – you can tell when they're on or off.

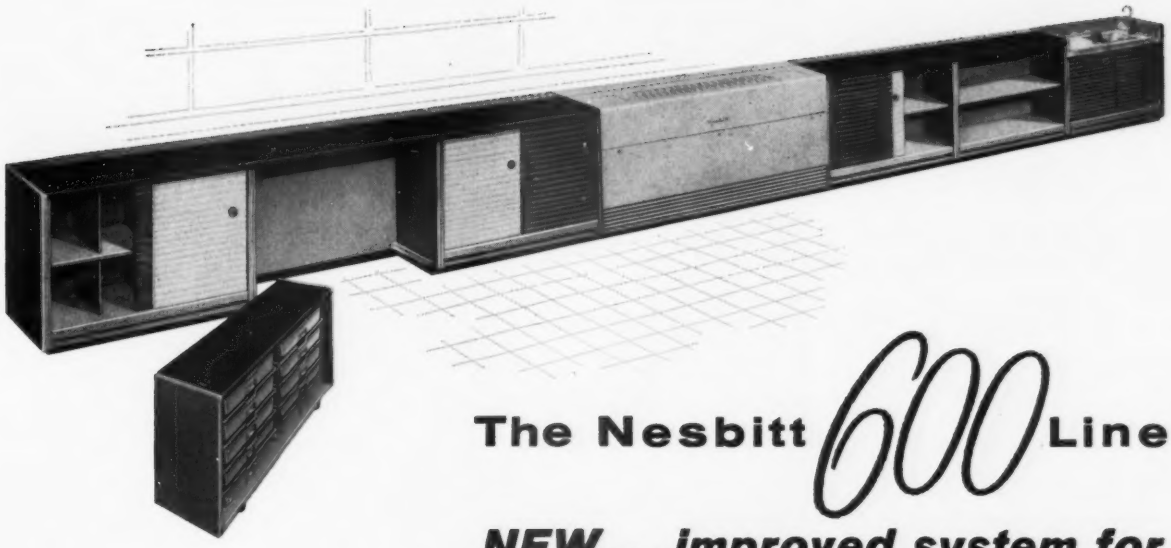
Available in Despard interchangeable type, Despard Type mounted on strap and narrow rocker for tumbler switch plates. A specification grade switch, 15 and 20 amps. 120/277 volts AC.

For more information write Dept. CE-106

P&S

PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK
60 E. 42nd St., New York 17, N. Y. 1440 N. Pulaski Rd., Chicago 51, Ill.
In Canada, Renfrew Electric Limited, Renfrew, Ontario

MAKE THE COMPLETE JOB COMPLETELY P&S



The Nesbitt 600 Line

NEW... improved system for

classroom comfort and economy

Wind-o-line Radiation makes the difference!

This new engineering publication for the Series 600 Line is now ready. Write for a copy of Pub. 10A1.

Of course you like the beauty of modern lines and colors . . . and you welcome the fact that these new integrated storage cabinets provide the mobility and flexibility demanded by creative teachers . . . but of prime importance to *you*, as a designer for classroom thermal comfort, is the fact that the features and advantages of Wind-o-line Radiation have been retained in the new Nesbitt Series 600 Line.

Wind-o-line solves the cold downdraft problem . . . but more than that: In a forced hot water system the copper tubing of Wind-o-line finned radiation serves as the supply and return piping for the Syncretizer unit ventilators in a whole group of classrooms. Costly pipe trenches, conventional mains, run-outs and pipe coverings are eliminated.

Syncretizer multiple serpentine heating elements deliver the required heating capacity with water quantities a third or less of those demanded by conventional elements; and the additional heating surface provided by Wind-o-line further reduces the water quantity. Smaller pipes and pumps are used.

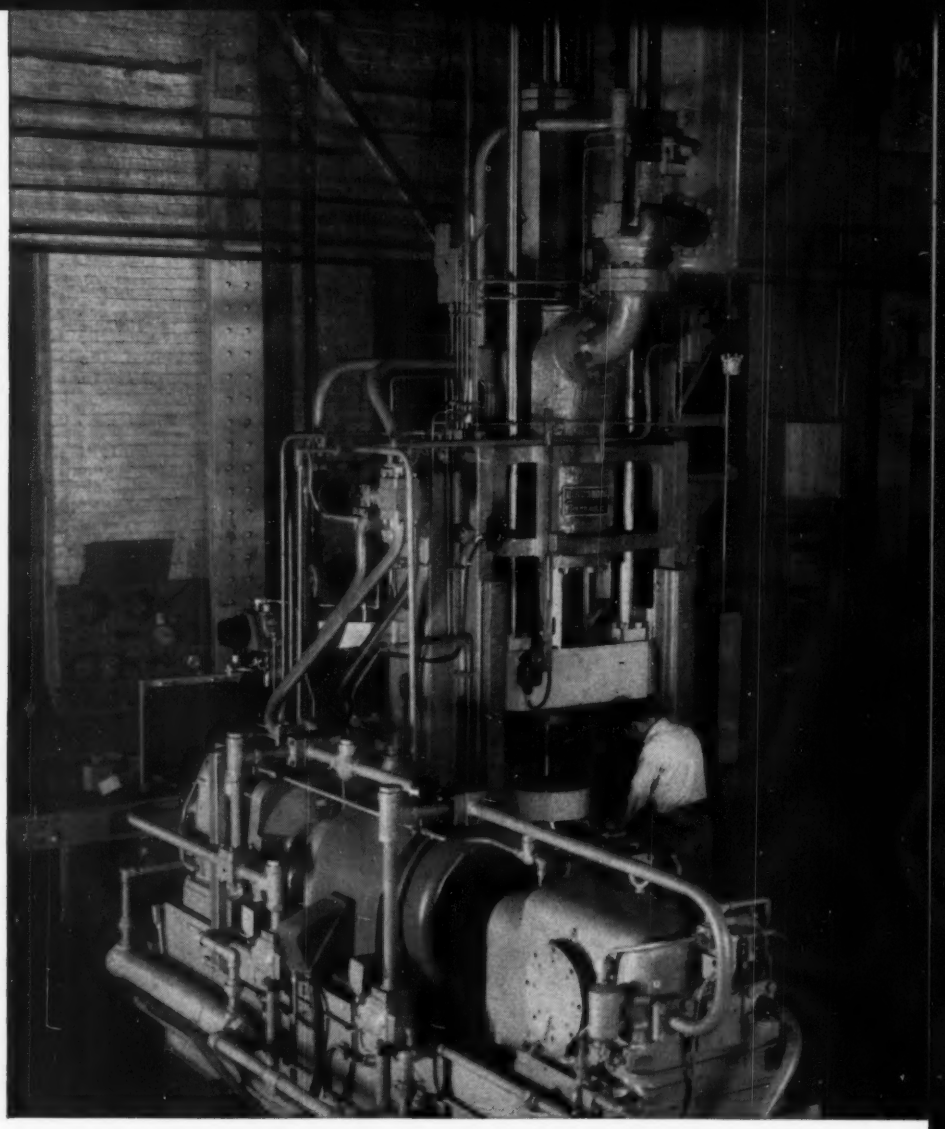
The gravity heating capacity of the Syncretizer with Wind-o-line radiation is more than sufficient to maintain adequate building temperatures during shutdown periods. Special controls and intermittent fan operation are unnecessary.

Thus, for daytime comfort, nighttime protection, and *reduced system costs*—WIND-O-LINE MAKES THE DIFFERENCE!

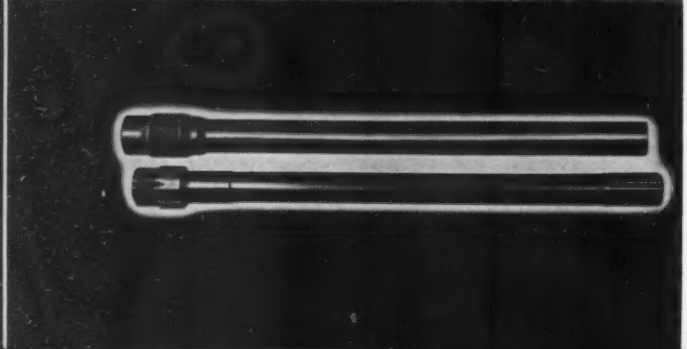
"For the Pursuit of Scholastic Excellence"

Nesbitt **COMFORT-CONDITIONED CLASSROOMS**

The Series 600 Line is made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.
Sold also by American-Standard Industrial Division, and American-Standard Products (Canada) Ltd.

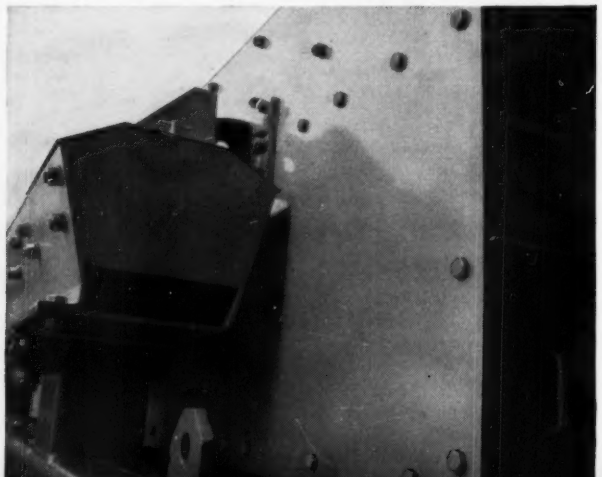


This 500-ton hydraulically operated press built by Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., and featuring Republic ELECTRUNITE Hydraulic Fluid Line Tubing, is used by a leading research center for deep drawing, extruding, or planishing metals.



REPUBLIC DIE-FORM CUTS PRODUCTION COSTS. Ford Tractor Power Take-Off Counter-Shaft costs less to produce using a Republic Die-Form Blank, as compared to previous materials. Because Republic Die-Form Blanks closely approximate the completed part, they minimize required machining and reduce handling costs. In addition, the nature of the Die-Form Process improves machinability of any given analysis, permitting further savings through use of higher speeds and feeds. Photo below shows a Die-Form Blank and the completed shaft as featured in the Ford Tractor. Write for Die-Form Folder ADV-746.

REPUBLIC CAP SCREWS PROTECT SHAKER SCREEN PERFORMANCE. Sorting and sizing ton after ton of jolting, jarring, abrasive material is all in a day's work for Ty-Rock Vibrating Screens, built by The W. S. Tyler Company, Cleveland, Ohio. Satisfactory performance under these brutal conditions not only requires design and manufacturing skill, but a thorough knowledge of materials. Maximum performance under all operating conditions is typical of Republic's complete line of top-quality Cap Screws. Send coupon for data.



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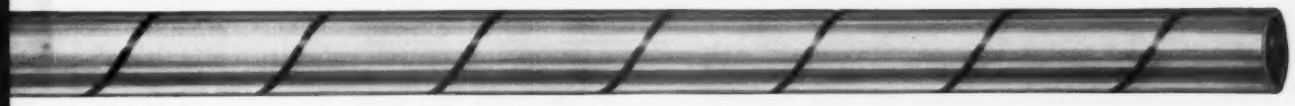

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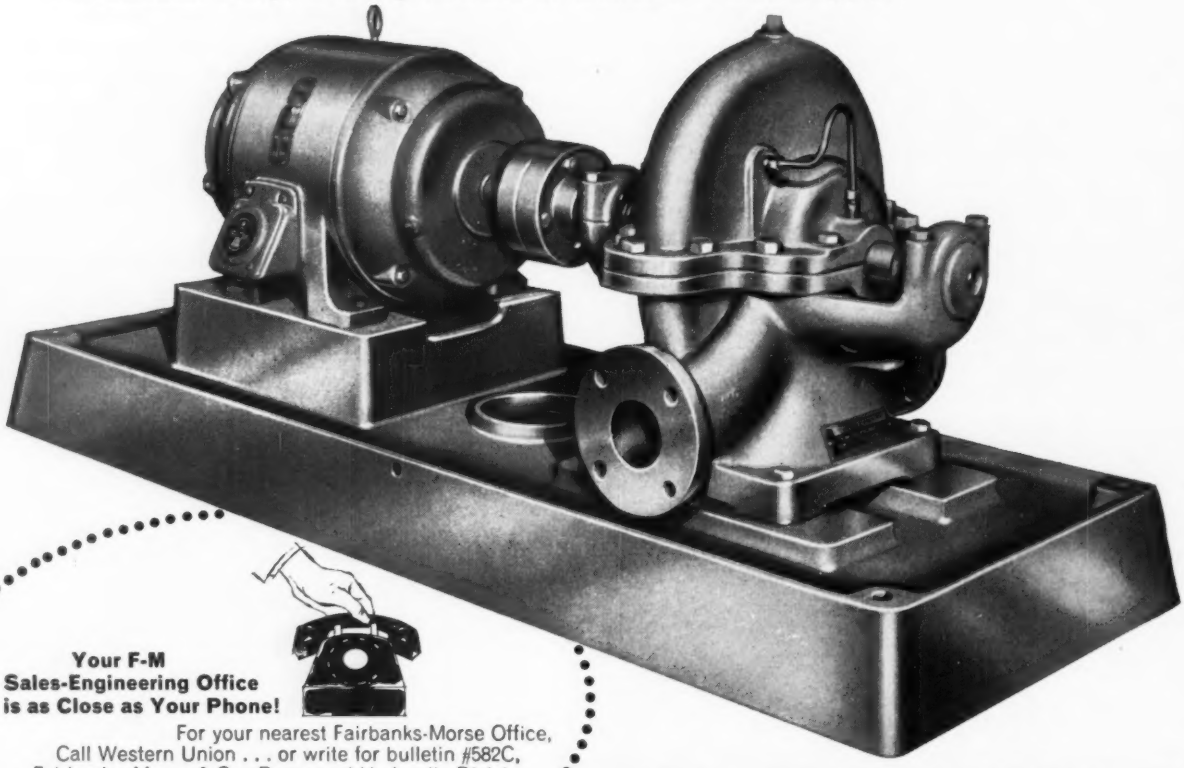

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A Hot River Hassle

FIELD NOTES

MARJORIE ODEN
Eastern Editor

THERMAL POLLUTION, a problem generally ignored in the past, is the subject of an intensive Pennsylvania research program. Engineering organizations, the state government, industries and utilities, and wildlife groups are cooperating in a study that will probably result in prototype stream pollution regulations. At least some recommendations are expected by the end of the year, and they will have multi-million dollar implications for industry.

If Pennsylvania Health Department proposals on control of thermal pollution go through unchallenged (and there is not a chance of this happening), it would cost Pennsylvania industry and power companies an estimated $100 million for installation of cooling towers and evaporation ponds, and for changes in manufacturing processes. Further cost estimates predict an additional $10 million will be needed annually for operation and maintenance of the cooling equipment.

Dr. F. J. Trembley, of Lehigh University, who has headed the extensive thermal research studies, explained what could happen if the nation continues to ignore the thermal pollution problem. He cited two authorities who predict that with industry and power's current rate of growth, all rivers in the United States would reach the boiling point by 1980, and by 2010 they would have evaporated. Dr. Trembley added that he does not expect things to get quite this bad.

Old Resolutions Unenforcible

For years, the Pennsylvania Sanitary Water Board regulations have included a provision that no industry or other water user could discharge wastes raising steam temperature more than two degrees F. There was no reference as to where the temperature was to be measured, and of course the vague ruling never has been and probably will never be enforced.

However, one of the large Pennsylvania power companies applied for a permit to operate a new plant. When they received the permit, with mention of the two degree limitation, they refused to accept it without more explanation as to how it would be enforced.

The Sanitary Water Board began investigating, and found there are no laws in any state giving a workable solution to the thermal pollution problem. Furthermore,

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there are no existing studies showing how high stream temperatures can be raised without harm — or what will be harmed.

According to the U. S. Public Health Service, the addition of substantial quantities of heat has the net effect of introducing additional pollution, because the ability of the stream or lake to assimilate the oxygen needed to combat pollution and to support fish-life is reduced.

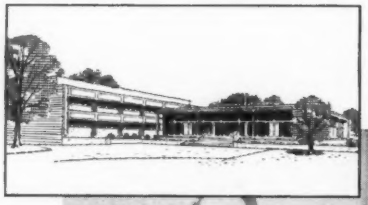
Probably the first regional group to consider the effects of temperature on streams was the Ohio River Valley Sanitation Commission, an agency organized in 1948 by the governments of the eight states that the Ohio River drains. Temperature regulations were recommended, but none of the states put the recommendations into law.

Of 43 states answering Pennsylvania queries, only four were attempting to do anything about thermal pollution and in all cases the laws and regulations are so vague as to be almost totally ineffectual. The Maryland Water Pollution Control Commission requires that the temperatures shall not exceed 100 F in a stream within a distance of 50 feet of any waste discharge. Although Minnesota has not adopted standards for temperatures of wastes, the Water Pollution Control Commission has considered each situation on an individual basis. The Oklahoma Water Resources Board has suggested certain broad temperature guides that indicate a temperature increase above normal stream temperatures for good streams of 5 F and fair streams of 10 F.

According to Dr. Trembley, Alaskan regulations state that no release of heated water should exceed the optimum temperatures for aquatic organisms. "The biologist will immediately ask what aquatic organisms, what are the accepted optimum temperatures, and at what time of the year does this apply? I would estimate that any Alaskan river might have 100 species of aquatic organisms, with the optimum temperatures known for a half dozen at most. In an expanding power economy, such regulations are worse than useless. They only compound confusion. Most states have no special regulations concerning the release of heated discharge waters. In most cases where the heated water problem has occurred, control has been handled under existing pollution laws. In many instances these laws do not fit the situations at all well," Dr. Trembley added.

Committee Appointed

When the Sanitary Water Board in Pennsylvania realized the magnitude of the problem, a committee was appointed with members from state chapters of the American Water Works Association, the Electric Association, the Sewage & Industrial Wastes Association, the



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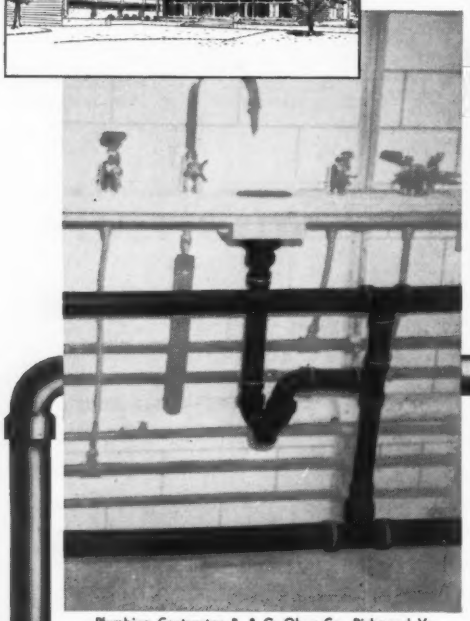

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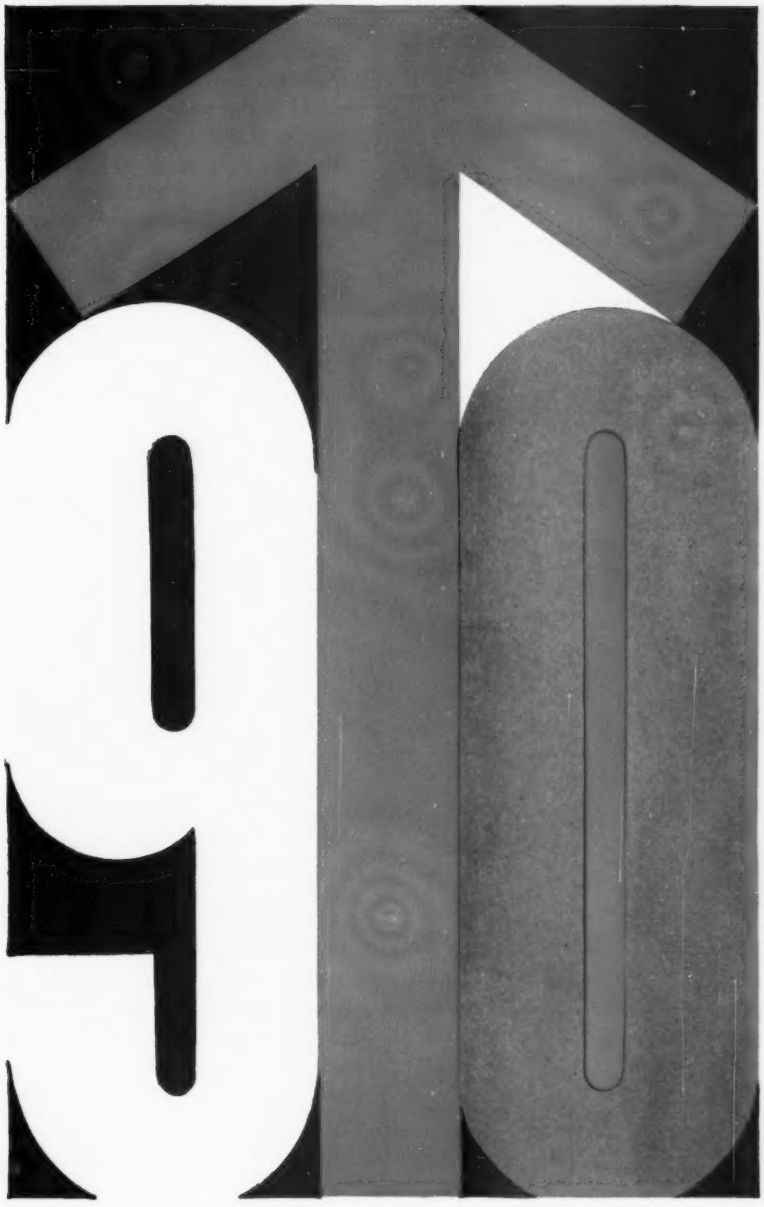

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Fish Commission, Mellon Institute for Industrial Research (speaking for the Chamber of Commerce and small industry), the Federation of Sportsmen's Clubs, the R. A. Taft Sanitary Engineering Center, the steel industry, and the Isaak Walton League of America, Inc. The League of Women Voters even sends an observer to the meetings. Chairman is G. E. Arnold, of the AWWA and the Philadelphia Water Department.

As Dr. Richard Hoak, of Mellon Institute, explained: "If there is to be a law, it is better that industry help in its formative stages than be subject to punitive parboiling itself."

The Health Department provisions, given as a starting point, suggest that regulations be established to:

¶ Prohibit discharge of wastes anytime, anywhere, above temperatures of 93 F from May through November, or above 73 F, December through April.

¶ Require reduction of heat content of liquid wastes from 35 to 85 percent, depending on the treatment required prior to discharge.

¶ Require any plant discharging such waste to maintain a fishway not less than one-fourth the width of the stream throughout the region liable to be affected by thermal pollution.

¶ Have the Sanitary Water Board allocate portions of the stream to each user.

Current Studies Provide Data

The most complete data to date has come from a study begun in 1956 at the Martins Creek Power Plant on the Delaware River near Philadelphia. The study was accelerated in the light of current statewide concern.

The Martins Creek plant uses 110,000 gpm of cooling water for production of 330,000 kw. With the exception of a short period of chlorination each day to prevent obstructing growth of aquatic organisms in the condenser tubes, this water is returned to the river unaltered except for its thermal load.

Arnold, going over preliminary findings from Martins Creek, explained that at one time the thermal discharge was emptied into a creek a short distance from the plant. It was learned that the heated effluent formed a channel along the river edge, with temperatures of 80 to 90 F. Since there are a number of resort hotels along the Delaware, and the river is used for swimming and fishing. Water temperature is important.

A series of jetties was built, and the discharge point changed to divert the warm water to the center of the river. Further studies showed that a "plug" of warm water covering about one-third of the central river was formed. With normal mixing, the warm area disappears in three or four miles.

The studies uncovered one surprise. Dr. Trembley said, "Quite

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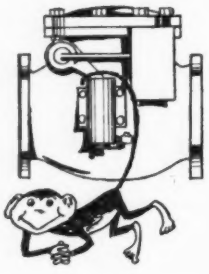

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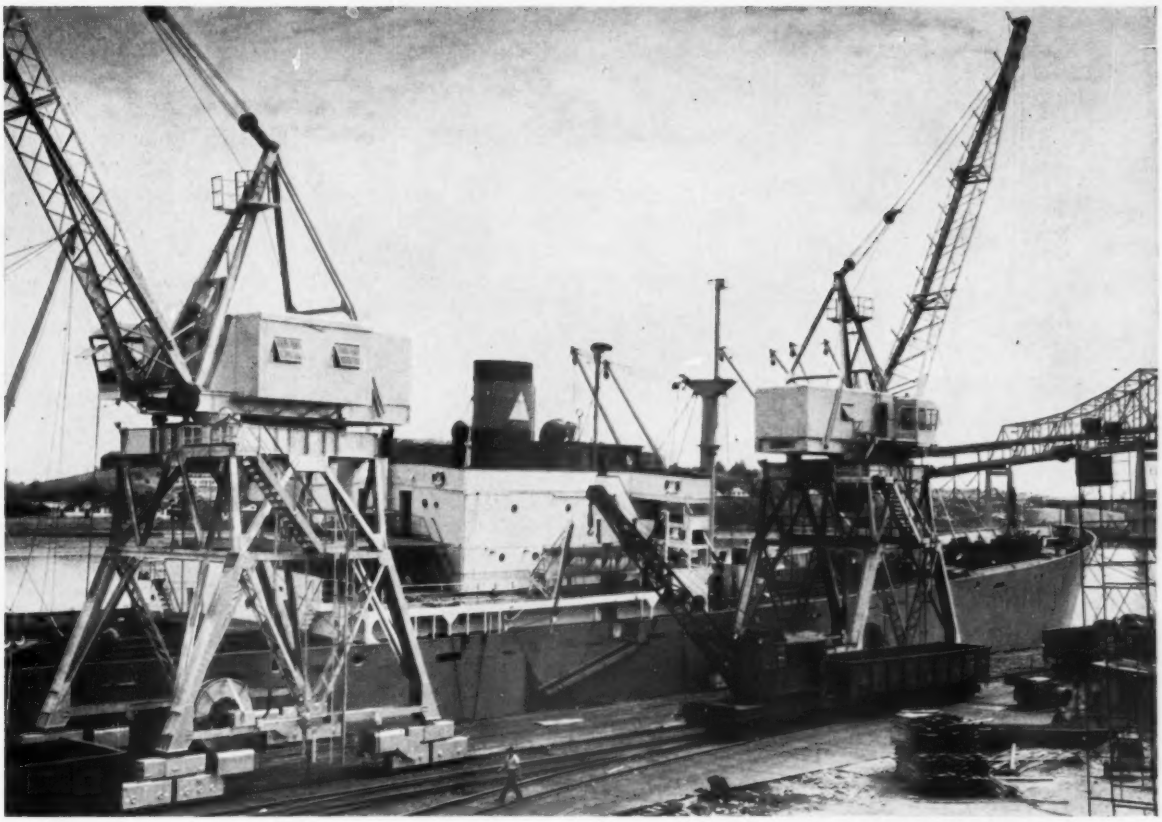

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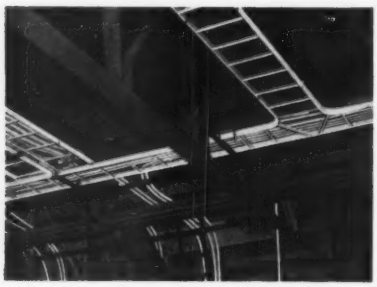

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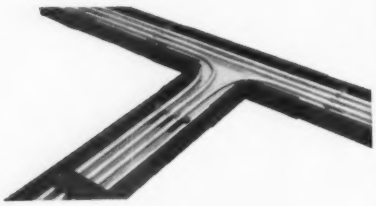

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contrary to expectations, the heated water zone seems to attract fish rather than repel them during most of the year. Forty species of fish have been taken in the heated water zone during the cold weather, cold water period of the year from about mid-September until mid-May. They move out of the area during the summer months. During the winter months when fishing is practically nonexistent on the rest of the river, fishing in the warm water area may be described as fabulous."

Dr. Trembley should know. In the interest of science, he and one of his assistants went fishing during a November snowstorm and caught 100 bass in one hour. "It was a strange experience to fish in a river with a water temperature of 65 F and an air temperature of 32 F or below, with steam rising from the heated section of the river."

The research is continuing. No conclusive data has been obtained on the effect of year-round warm water on the animal or vegetable life in the river.

Other Studies

The steel and powder industries have cooperated in other extensive studies of thermal pollution this summer. In a 100-mile area on the Allegheny, Monongahela, and Ohio rivers near Pittsburgh, almost daily temperature studies have been made.

Another steel company study was conducted on the Susquehanna near Harrisburg. On this portion of the river, which is wide and shallow, one steel company has a large plant with multiple discharges. It was discovered that the heated water clings to the shoreline in a five-mile channel, until the mixing of a creek causes it to dissipate. Jetties could do the job sooner, but there is no need for them in this case because the river is not used for recreational purposes. Problems encountered to date have been quite varied. For example, the Health Department proposals indicate that one-fourth of the stream must be kept clear for a fishway. Yet sometimes, the heated water spreads on the surface instead of forming a channel. An engineer cannot guarantee that one-fourth of the water on the bottom will remain at a certain temperature.

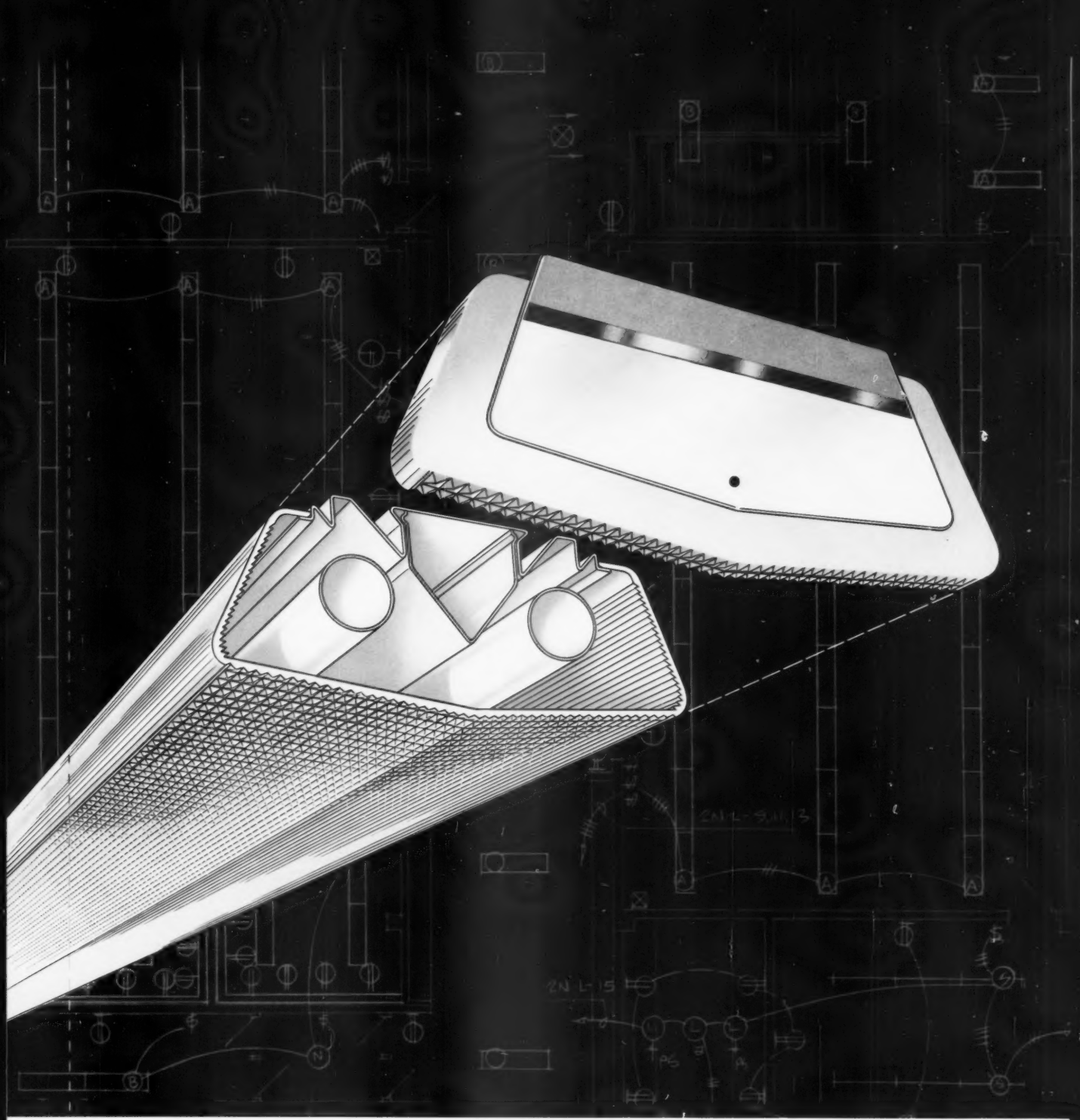
Water temperature makes a difference to municipal water customers. Chairman Arnold pointed out that, "there is a saving of 30 to 50 cents in chemicals per 10 degrees increase in temperature per million gallons of water treated. On the other hand, elevated temperatures sometimes increase the growth of certain types of algae which create taste and odor problems for the water works operators." It was concluded that the benefits of cool water approximately balance the cost saving in chemicals from warmer water.

Most pressing problem right now, of course, is economics. "We could wind up with very cool streams and no industry at all," Arnold commented.

If industry is required to install cooling equipment, one engineer questioned said it would not mean as much business for consulting engineers as might be expected. Only the larger plants would call in consultants to plan for needed cooling facilities, and many large plants have their own engineering departments. The smaller industries are likely to lean heavily on "free engineering" offered by cooling equipment manufacturers.

Early recommendations, based on the preliminary studies submitted this month, are expected to be far from unanimous. The Wildlife people are fond of their fish, and industry is concerned about costs. The Health Department wants blanket rules, easily enforced, and industry wants each case judged on the basis of prevailing conditions.

The research is expected to continue, but token regulations are expected next year. ▲▲



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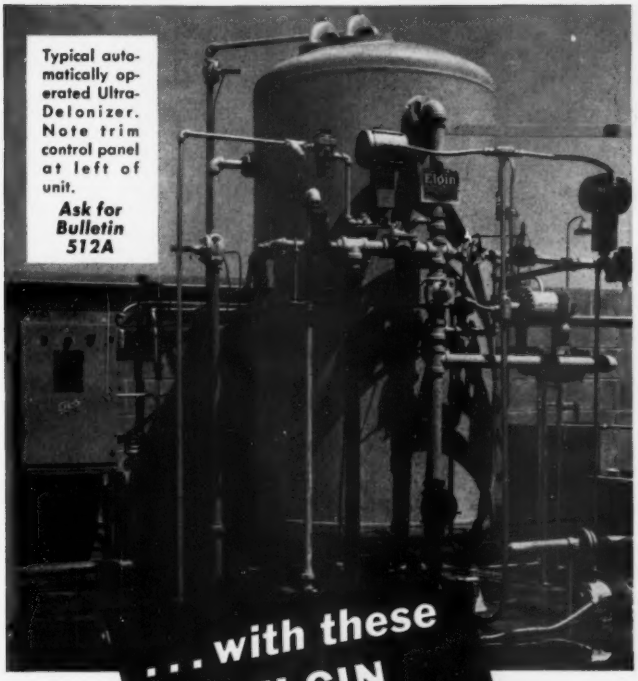

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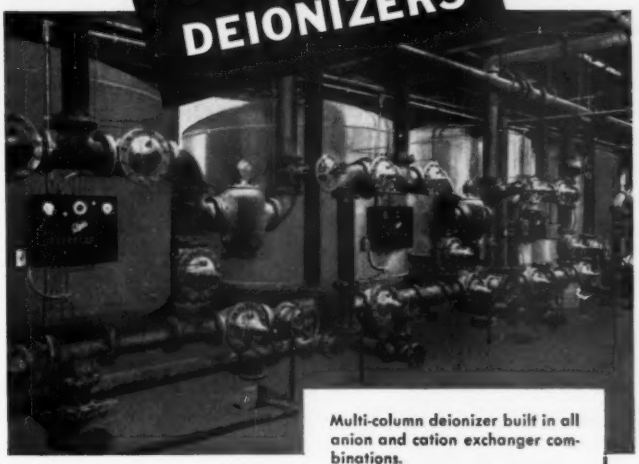

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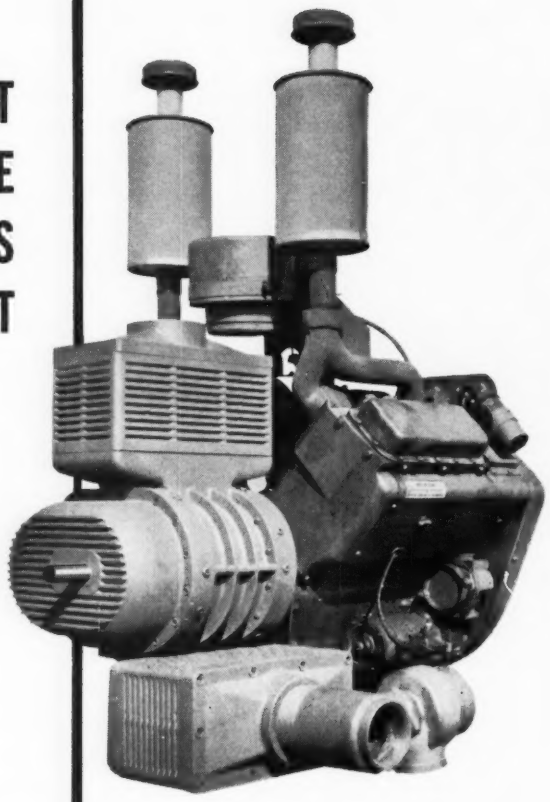

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Highways Need Long Term Plan

"The major advantage of the long-range, 15-year Interstate construction program is that it enables highway departments and industry to plan ahead, so that the program can be developed, supported, and executed with maximum efficiency and economy. But how can industry plan efficiently to support a 15-year program which Congress says it wants but fails to support adequately? We must have our long-range program adequately and soundly financed. We hear considerable talk of climbing costs, but the fact is that the unit cost of construction of a composite highway mile, is shown by the most recent quarterly price index prepared by the Bureau of Public Roads, is actually a few points lower today than it was in 1956. Competitive bidding in the highway construction industry is fierce, with a nationwide average of about seven bidders per contract.

"That kind of competition means, I can assure you, that industry, as well as government, is extremely cost conscious. If anyone here knows a way to engineer and build these highways at costs substantially less than today's prices, he has a brilliant future in the highway business. We are as certain as anybody can be certain of anything that highways will never be a better buy than they are today.

"There are, of course, other ways of transporting goods and people. I do not disparage any of them. Waterways, railways, pipelines, and airways all have their special advantages. In a growing America, we need all of them. Yet, it seems evident to me that our greatest deficiency and our greatest opportunity for expansion lies with the highway system." — Louis W. Prentiss, Exec. V.P., American Road Builders' Association to the *Minneapolis Rotary Club*, August 1960.

The States and Nuclear Power

"It is already clear that reasonable expenditures for research and development will be allowed by the vast majority of [state] commissions. The decisions have been so consistent, and the attitude indicated by those commissions that have not yet been called on for decisions has been so nearly unanimous, that it might appear that this matter could never have been in doubt. To so conclude would be seriously to discount the significance of the position that has been taken. Electric utilities have not generally, in the past, shown on their books large expenditures for research and development and asked the regulatory commissions to approve them. The equipment manufacturers have customarily done the research and made the improvements, and the costs have shown up on the utilities' books only in the form of the prices paid for their equipment. So the commissions were not simply following well-established precedents in allowing these expenses. That is why so many utilities have applied for and received accounting orders. Significant commission decisions were required. They have been made and quite apparently will continue to be made. The Michigan commission set the tone in its 1955 decision D-1282A-55.1, *supra*, when it said: 'It does not seem prudent for the petitioner, a utility, to await the time when manufacturers of equipment related to the generation of electric energy might be prepared to undertake the design and construction of a fast neutron breeder reactor. . .' The result has been highly favorable to private development of nuclear power.

"On the question of certification of nuclear plants and the allowance of their full cost either in the rate base or by amortization as expense, the precedents are not yet conclusive. But the desire of the commissions to encourage their construction, to the full extent that it can be justified, is clear.

"It is clear also that the basic question in every case will be that

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of public convenience and necessity. Once a commission has decided that public convenience and necessity require the building of a plant, it will have no difficulty with the details. The utility will be permitted to recoup its capital costs, even though only the costs of an equivalent conventional plant may be capitalized and the balance may have to be amortized as expense. It will be allowed its full fuel costs, whether the fuel be leased or purchased from the AEC, its full insurance costs, its expenditures for necessary research and development, and any other reasonable costs involved in the construction and operation of the plant. The commission that cannot find these costs to be reasonable and justified will find that public convenience and necessity do not require that the plant be built and will deny the application for a certificate." — from *State Regulation and the Future of Nuclear Power,* published by the United States Atomic Energy Commission, June 1960.

Secrecy in Government

"Were it not for the secrecy which hides the hard core of the matter, the intelligent public would be quite capable of judging the questions under discussion. The fear of being guilty of judgment based on a partial knowledge of the facts misleads many judicious people into accepting judgments by others whose knowledge is often even more partial but which extends into the dread domain of the secret and top-secret.

"When secrecy intervenes, an informed public opinion can hardly exist. Too often we have, instead, a manipulated public opinion formed by leaks, half-truths, innuendoes, and sometimes by outright distortion of the actual facts. . .

"The difficulty of secrecy within the government is that, unless administered with the greatest wisdom, it furthers confusion, which comes from ignorance or partial knowledge, and often results in inaction or unwise acts. The farcical snafu of the U-2 incident with all its overtones of tragedy shows how great the costs of secrecy can be, even in the highest echelons of government.

"We can now ask ourselves, what have we really gained from our exaggerated secrecy in the way of real security? Actually, very little. The Russians are not far behind us in atomic weapons, but our allies have been left way behind, after expending an enormous treasure in trying to rediscover facts and techniques already known to the Russians as well as to ourselves." — I. I. Rabi, Columbia University physicist, in *Atlantic Monthly,* August 1960.

Legal vs Ethical Problems

". . . before we can begin to approach any real ethical problem we must first accurately determine whether the problem is a legal violation or whether it is an ethical violation. To some this might sound elementary and obvious. But believe me, ignorance of this difference on the part of our rank and file is our main worry.

"To be a legal violation, the violation must be in direct conflict with the wording of the state law. This is not so simple as it sounds. You can walk across a street or drive across a bridge and enter another one of our 50 states where a legal violation no longer is a legal violation.

"With regard to legal violations the State Board of Examiners has sole jurisdiction. Engineering societies or groups have no business handling legal violations except in an advisory capacity as requested by the Board.

"An ethical violation is in no way in conflict with state law. State legislatures do not pass laws to police the ethical practices of any profession, yet many of our ill-informed brethren are laboring under this illusion. An ethical violation can be handled only by engi-

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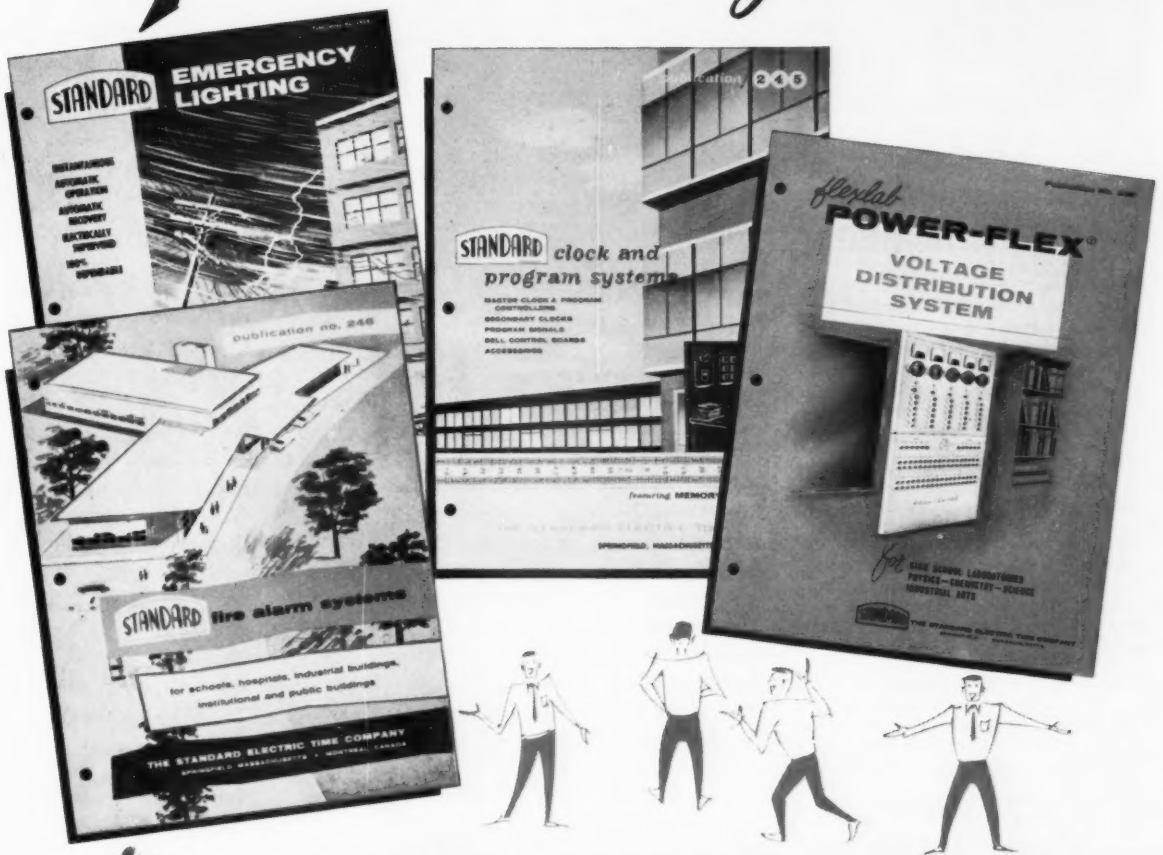
4 ELECTRICAL SYSTEMS by STANDARD



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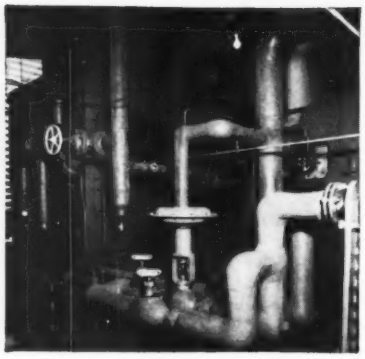

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The only really precise method of air conditioning because it removes moisture as a separate function from heating or cooling to give you assurance of accuracy of air moisture control.

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This method is successfully used in the storage, testing and production of hygroscopic materials, in process control and as a pre-dehumidifier in comfort air conditioning.

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neering groups or societies and Boards of Examiners have no business or jurisdiction in such matters.

"With regard to legal violations in this country today, our various State Boards of Examiners are doing an excellent job of enforcement. On this score we have nothing to worry about.

"With regard to ethical violations in this country today, enforcement of same by our local societies and associations down at the grass roots level, where it really counts, for all practical purposes is nonexistent. When the attention of our state society is called to a violation and when it is seen that the buck cannot be passed to the State Board of Examiners, then everybody runs out in the alley to vomit. Usually for about six months the matter is discussed and then, inevitably, it is swept under the rug and forgotten about." – Joe Williamson, Jr., to the *Consulting Engineers Institute*, sponsored by the University of Wisconsin, June 1960.

Science Cannot Be Ignored

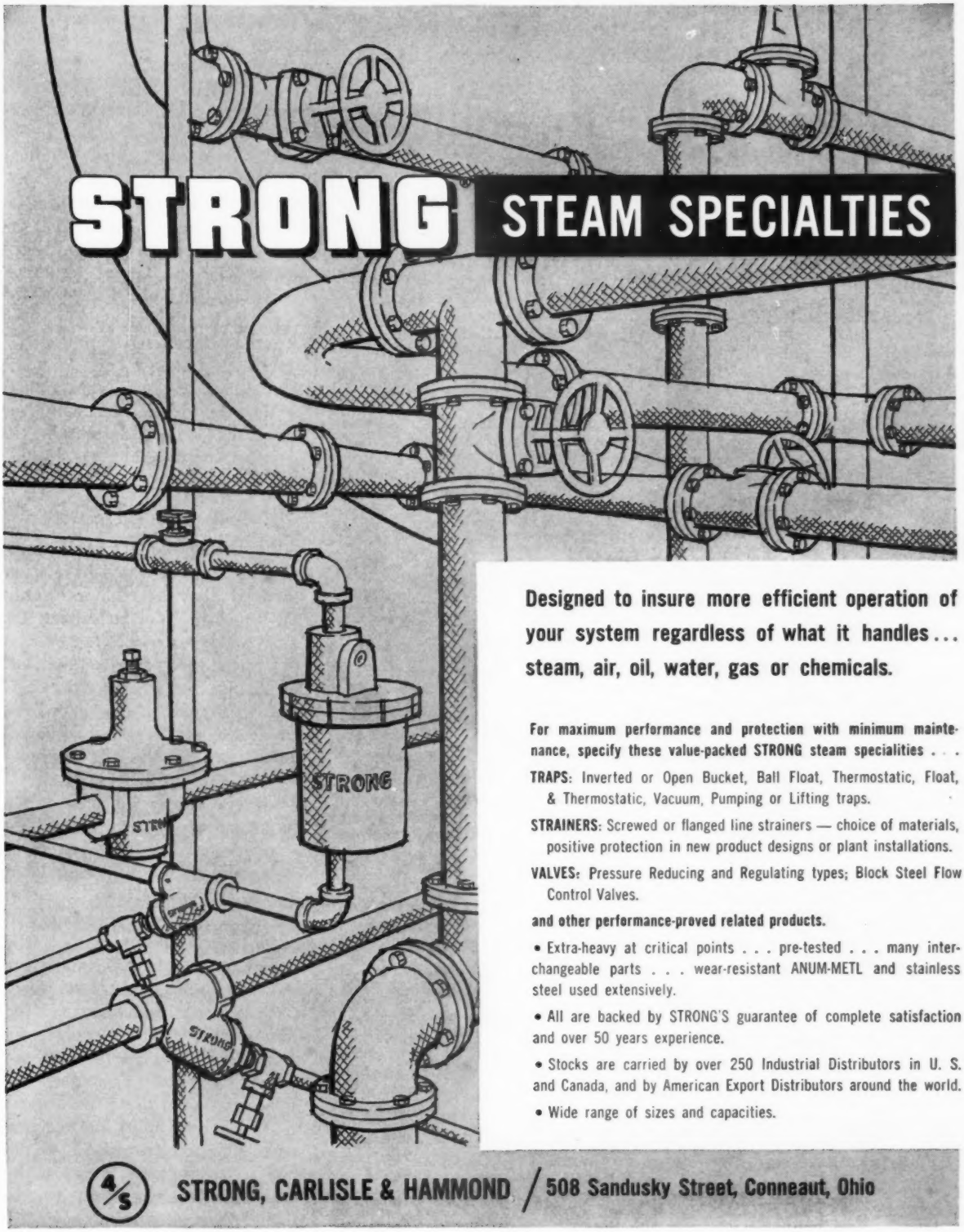
"The civil engineer today can no more ignore the methods and achievements of pure science than can the statesmen ignore the intercontinental missile and the Pentomic Army. As civil engineers we cannot afford either professionally or financially to rely entirely on empirical methods to solve the complex problem of modern design and construction. Just because the Pont du Gard stands as firmly today as when the Romans built it, it does not follow that we should close our eyes to new and perhaps radical concepts of bridge design suggested by modern materials and construction methods. I do not suggest that we should all become pure scientists, but rather that we strive to understand them better and to apply the fruits of their basic research to modern civil engineering problems. The American civil engineering profession can no longer afford to feed its strong and virile technology on the crumbs of scientific knowledge which fall from the tables of European research." – Brig. Gen. Alden K. Sibley, in the *Journal of the Boston Society of Civil Engineers*, July 1960.

Business vs Government Abroad

"Within the typical American overseas community there is one area of partially hidden conflict that augurs ill for the American position in a number of countries. The traditional American view that 'we need less government in business and more business in government' has been extended abroad. The lack of understanding that exists between Americans working for the government and Americans working for private enterprise is seen in the gap between the business community and the government community at many overseas posts. At its worst, the two groups look at each other as if each were in the country solely to thwart the interests of the other. The extreme business view holds that U.S. government offices abroad are there to hinder business operations, not to help. The extreme government view would be that the average American business is operating to the detriment of the United States, for the object of business is to extract rather than contribute." – from *The Overseas American*, McGraw-Hill Book Co., 1960.

Highway Bureaucracy

"Your brief editorial on 'Highway Leaks,' (May 20), points out, but not strongly enough, the 'Great White Father' role of the Federal government in the Interstate Highway program. The duplication of engineering effort of the state highway departments and the Bureau of Public Roads in the highway program is, and should be, a cause for much greater concern than the Oklahoma incident you refer to. There are thousands of hours of engineering time presently being wasted in shuttling plans back and forth from districts and divisions



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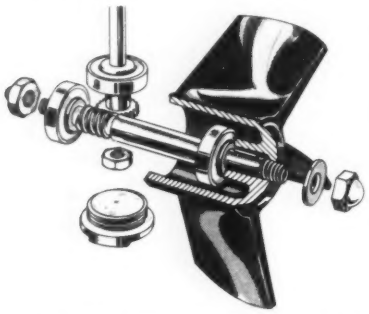
SPARLING METERING TOPICS

Design and Durability of Propeller Meters Insure Low Maintenance

SIMPLICITY OF DESIGN and rugged construction insure years of trouble-free operation with propeller meters. The only moving parts are an accurately molded one-piece propeller, two shafts, self-flushing bearings and a simple worm and gear mechanism. All parts are of material specifically adapted to service requirements. For example, the propeller of a Sparling meter is molded of a tough, resilient plastic that holds the exact pitch and set of the blades for the life of the propeller. Bearings, shafts, and the worm and gear mechanisms are of stainless steel. Change gears are readily accessible should units of registration need to be changed.



Periodic inspection and one-point lubrication are usually all the maintenance required for a propeller meter. When further service is necessary the entire meterhead may be easily removed as a unit with minimum shutdown time.

ACCURACY... Sparling main-line propeller meters consistently register total flow with accuracy guaranteed to be within 2% of true flow, at all velocities within the rated range of the meter. Each meter is individually tested at the factory to establish its true index; then it is properly geared to maintain accurate registration.

DIRECT TOTALIZING... No conversion charts, tables or computations are needed with a Sparling propeller-type meter. Total flow is read direct on the 6-digit, straight reading totalizer furnished in standard volumetric units specified. If both total flow, and rate of flow are required, a Sparling meter-mounted Type 245 Indicator-Totalizer can be utilized. Suitable instrumentation and controls for remote reading and recording are available.

NEGLIGIBLE HEAD LOSS... The straight full pipe size bore of a Sparling meter offers the minimum interference to flow. Pressure recovery equipment is not necessary. A propeller-type meter operates with the same high degree of efficiency in any position—horizontal, vertical or at an angle—and may be placed in either the pump suction or discharge piping.

COMPLETE RANGE... Sparling water control equipment has been specified for nearly 50 years by water and sewage works engineers and superintendents everywhere. A complete range of instrumentation and control equipment permits Sparling to meet most any main-line metering requirement. Ask your Sparling field representative for further information, or WRITE FOR CATALOG 315CE.

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within the state highway departments to districts, divisions, and regions of the Bureau of Public Roads. As time means nothing to bureaucrats, urgent highway projects often take months to make the circle of bureaucrats for approval with no constructive purpose being served in the process.

"In addition to having the nation's largest power company, largest airline, and largest insurance company, the Federal government also now has the distinction of having the largest engineering staff.

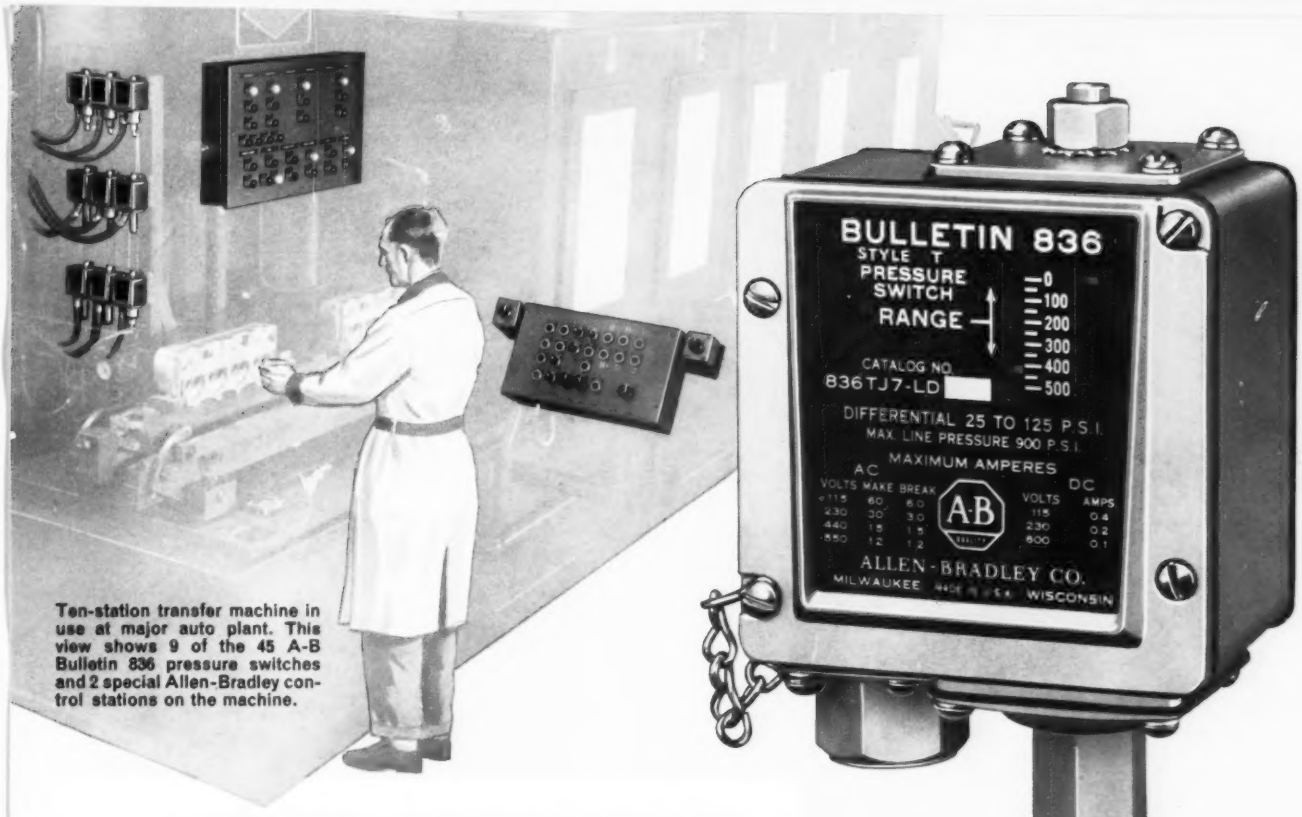
"This is certainly quite a record for a President who campaigned against the growth of Federal bureaucracy." – Donald A. Walsh, in a letter to the editor, *The Wall Street Journal*, June 7, 1960.

The Municipal Consultant

"It is not proposed that all engineering services which have been outlined above should necessarily be furnished by a consultant, for many of these services can best be provided by engineers on the staff of the city. But whatever the engineering service a city or village may need, that service can be secured from a consulting engineering firm.

"Several factors will bear on the propriety of utilizing consulting engineer services. The services of a consultant should be considered if: (a) the project is so large that the city's existing engineering staff cannot handle the work, (b) it is apparent that the city's engineering staff has insufficient experience in the type work involved, or (c) the over-all expense of the engineering work will be less if consultants are used rather than expanding the staff as required to do the work.

"The responsibility of deciding when and to what extent to depend on consultants is that of the city officials. The desired goal should always be the best engineering service at the most economical cost to the taxpayer." – by Robert Mahan, Burges & Nipple, in *The Ohio Engineer*, August 1960. ▲▲



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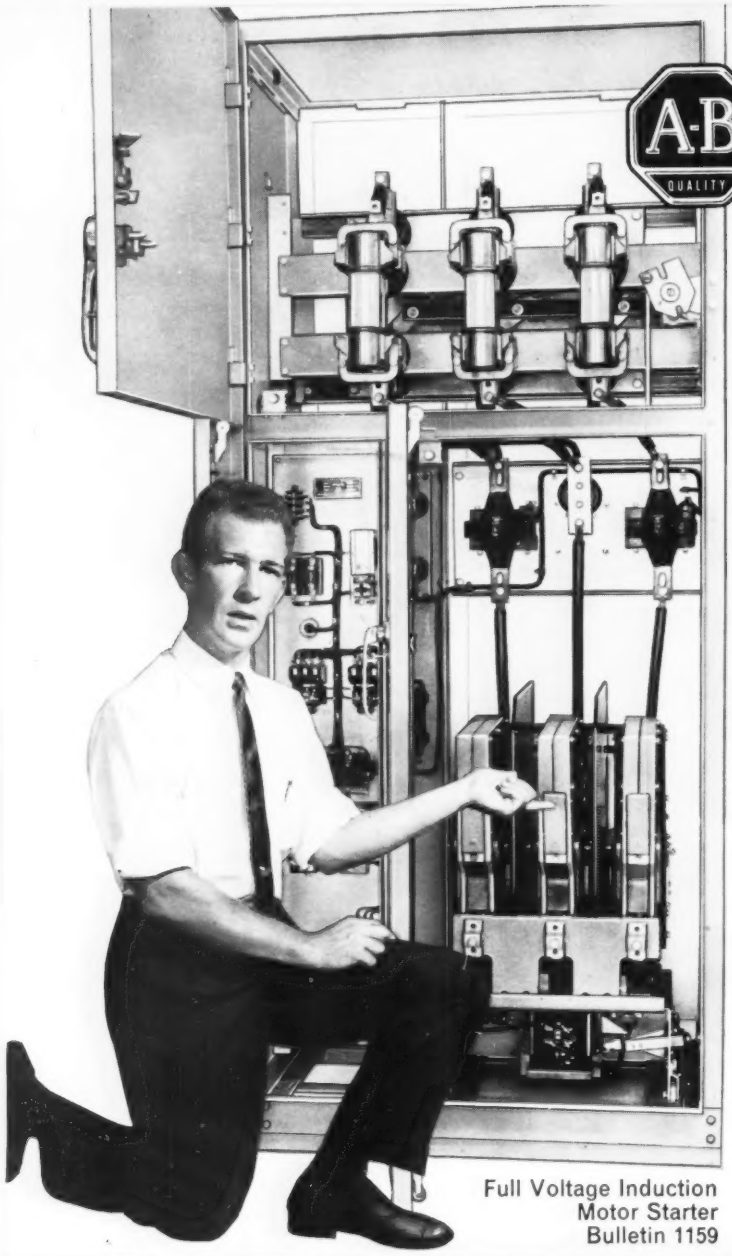

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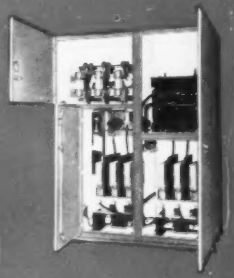

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Bulletin 1172

Full Voltage
Synchronous Motor Starter
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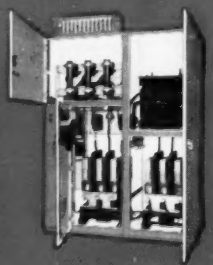

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Synchronous Motor Starter
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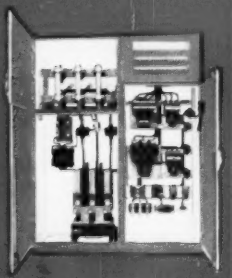

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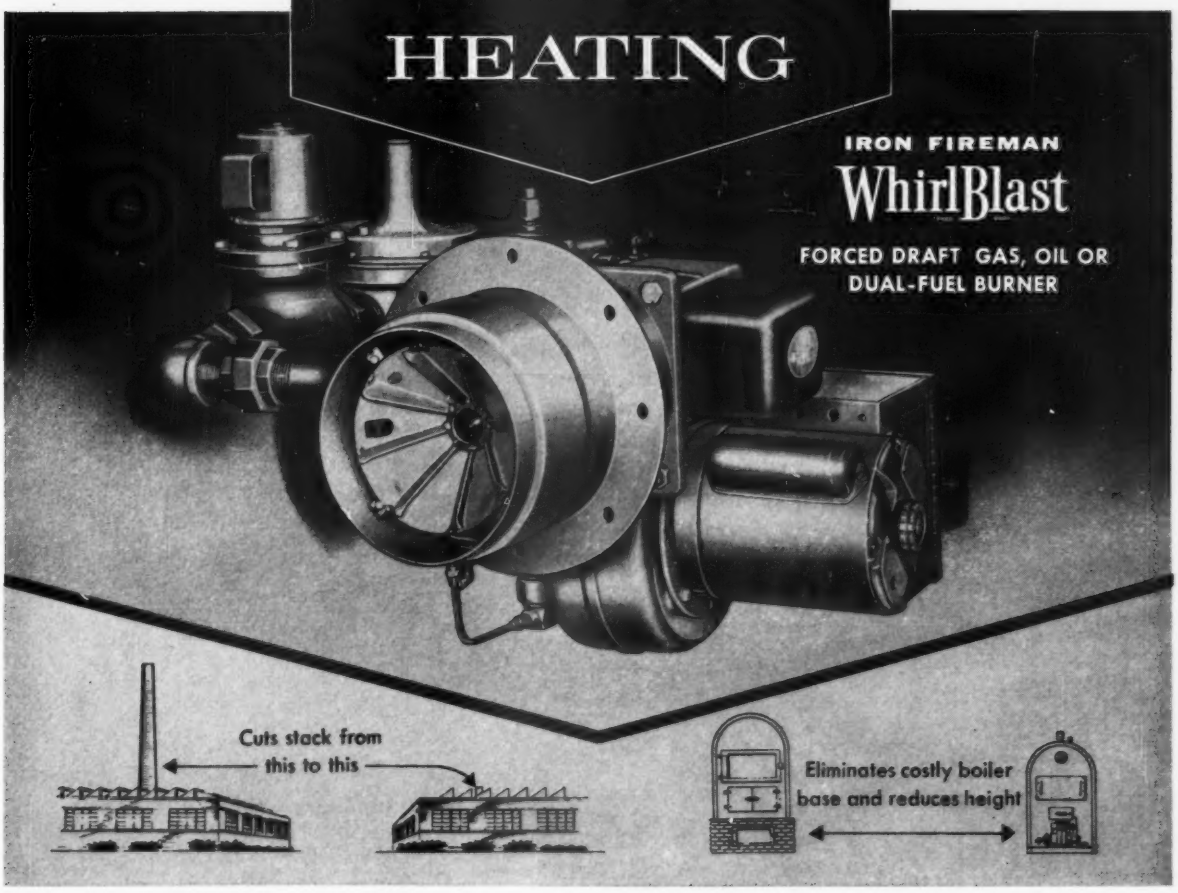

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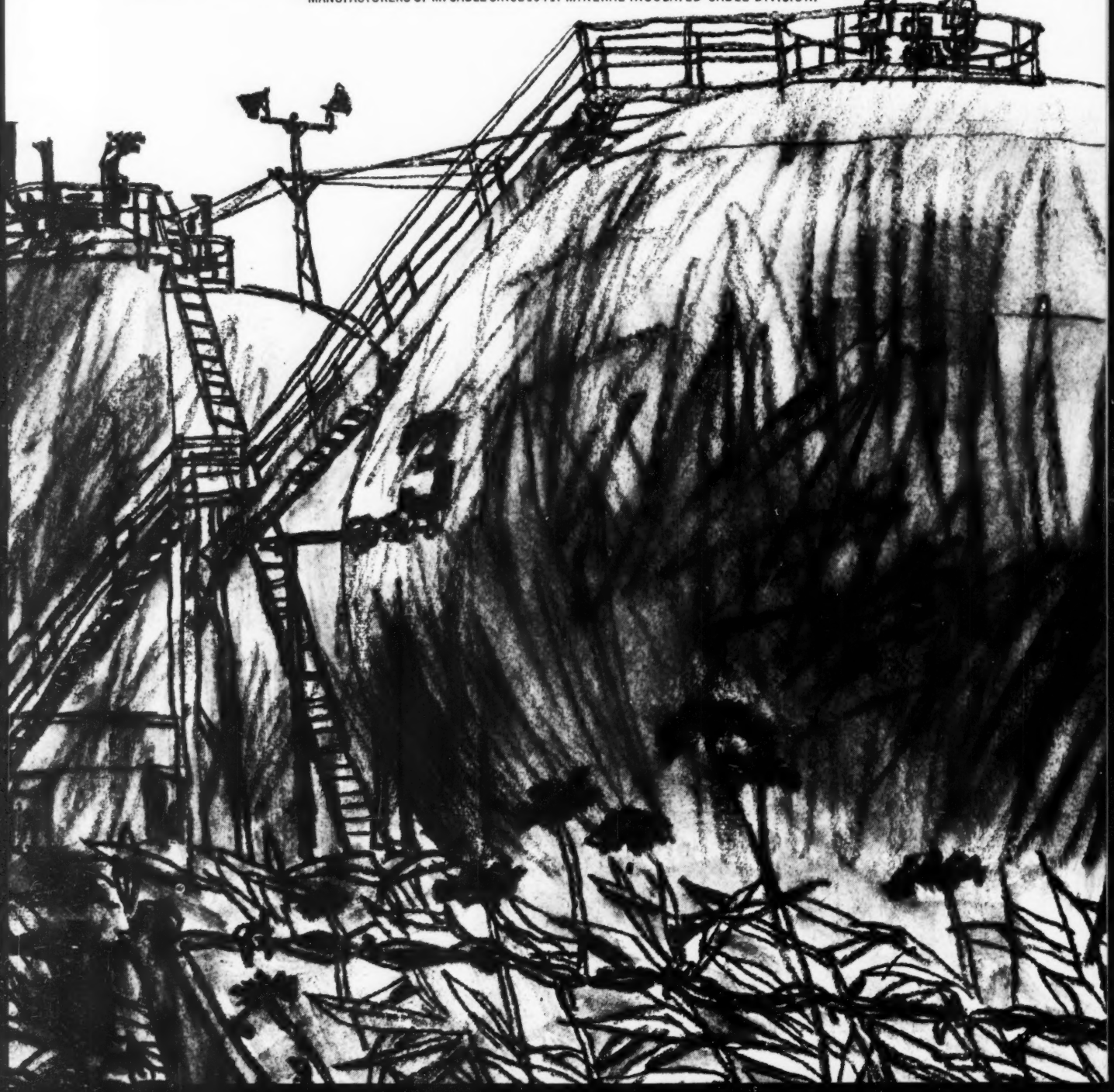

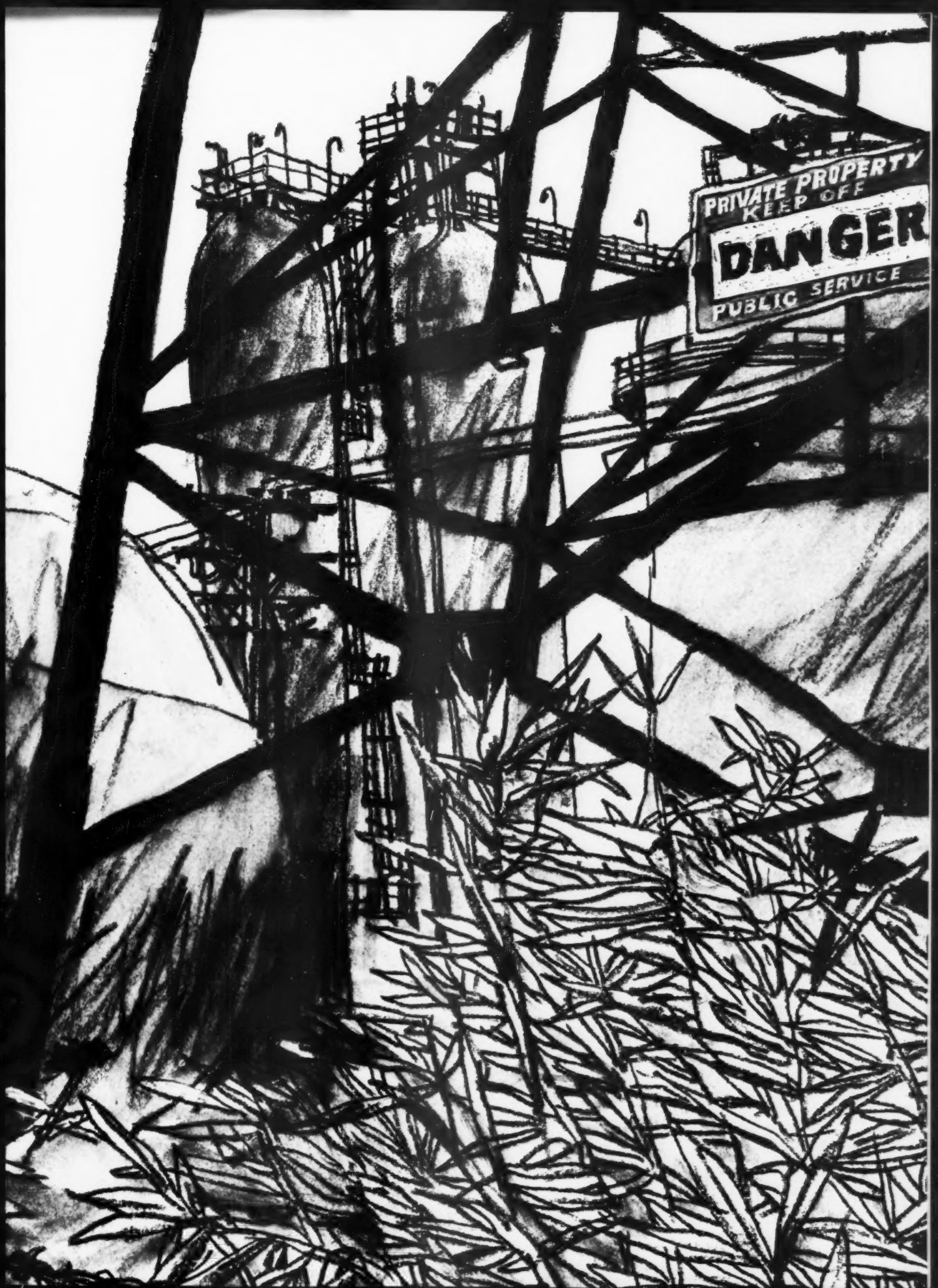
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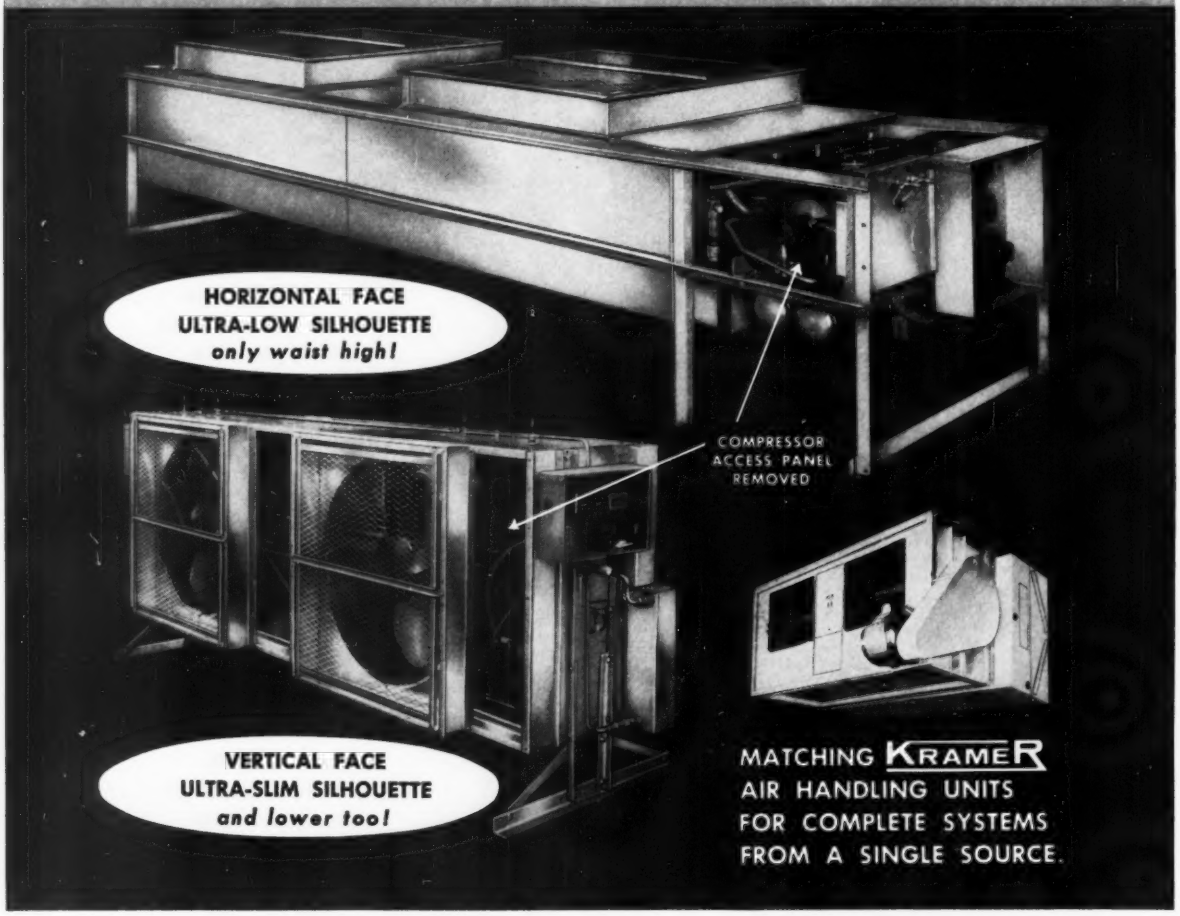

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47 YEARS OF CONTINUOUS ACHIEVEMENT IN HEAT TRANSFER

The Word From Washington

EDGAR A. POE, Consulting Engineer Correspondent

With rapidly growing metropolitan areas decaying at the core, something must be done to stem the blight. The nation today has 192 metropolitan areas governed by 16,000 local jurisdictions. Thus, it is extremely difficult for them to maintain even a semblance of orderly growth.

Because of this situation, which is completely out of control in some metropolitan areas, the Committee for Economic Development (CED) has come up with a four-point program called "Guiding Metropolitan Growth."

CED is a committee of leading businessmen. The nonprofit, nonpolitical economic research organization is urging the metropolitan areas to develop new forms of government in order that plans may be formulated and carried out on an areawide basis.

Bureau of Census figures show that 80 percent of the rapid population growth in metropolitan areas is taking place in the suburbs rather than the central cities. By 1975 an estimated 140 million Americans will live in metropolitan areas, and at least 80 million will live outside the central city. Industrial development likewise is expected to continue its outward shift to suburban and rural areas.

In a 50-page printed report, released in Washington by T. V. Houser, chairman of CED's Research and Policy Committee, and Jervis J. Babb, the Committee insists that the time has come to realign local governments in metropolitan areas to enable them to carry out public responsibilities which are clearly metropolitan in scope. The research published in the report covers a two-year period and is of interest to consulting engineers who are employed by municipal and metropolitan areas.

"Failure to establish metropolitan governments with wide powers will," said the committee, "lead to a greater loss of self-determination in local affairs through the continuous transfer of responsibility to higher government levels.

In a pertinent observation the large CED Committee, which includes some of the most widely known citizens in America, declared that the metropolitan area problems are so great in scope and are of such mounting importance that they will eventually compel governmental action. However, the Committee recommended that

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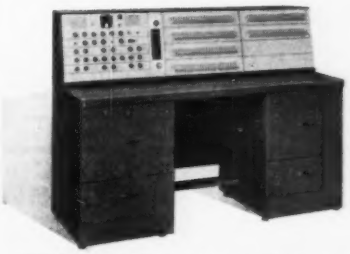

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these governmental policies should be developed and carried out at levels of government close to home.

"These matters – transportation, air pollution, and the like – cannot be tackled by small local jurisdictions," said the report. "A metropolitan level of government could cope with these matters . . ."

Urban Renewal Guide

Issuance by the Urban Renewal Administration of a technical guide called "Selecting Consultants for Project Planning," is now available at 25 cents a copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25. D. C.

Success of an urban renewal project depends substantially on the amount of engineering blueprinting and planning that is devoted to the project and the skill of the consultants, the technical guide declares. Therefore, a community should take the necessary steps to assure itself of qualified professional assistance in executing planning.

The publication states that some communities, with several projects in various stages and a continuing Title I program, assemble and retain a permanent staff for project planning. Others have discovered that it is more feasible to obtain the services of a consultant or the entire planning job.

The technical guide maintains that when a community decides that consulting services are needed, it will pay a community to carefully select the firm to be retained. It then recommends ways designed to aid in investigating available consultants and following through to make the best possible selection. It also provides guides for analyzing local needs to determine what type of professional services should be secured, obtaining information on experience and qualifications from the firms to be considered, and reaching a definite agreement with the firm selected.

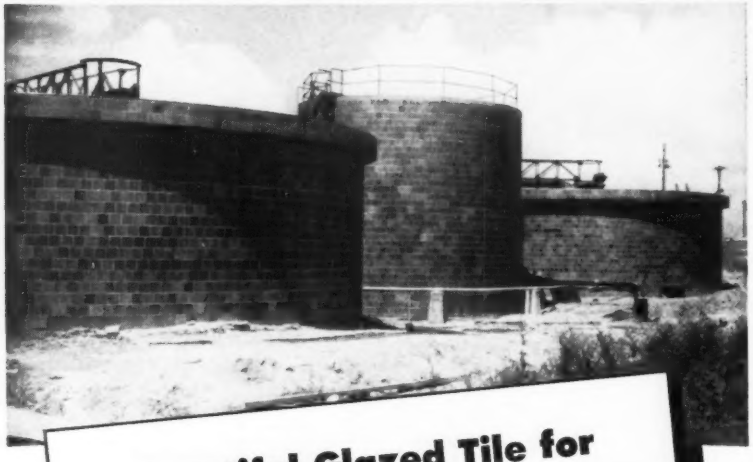
Exporting Free Engineering?

A new company founded on the idea of promoting the free enterprise system and aiding in the industrial development of underdeveloped countries has been set up in the District of Columbia.

George E. Webster, a University of Maryland engineering graduate, is president of the company. Before leaving Washington for a three-week around the world jet plane trip, Webster said his organization is a catalyst between United States manufacturers and businessmen and governments in the less developed countries.

He said government will be asked to provide land for small industries for plants to be designed by manufacturers in the United States. His company, "International Small Industry Development Corporation," will arrange for money to invest in plant and equipment, with U. S. manufacturers giving

Effluent and Water Treatment Tanks



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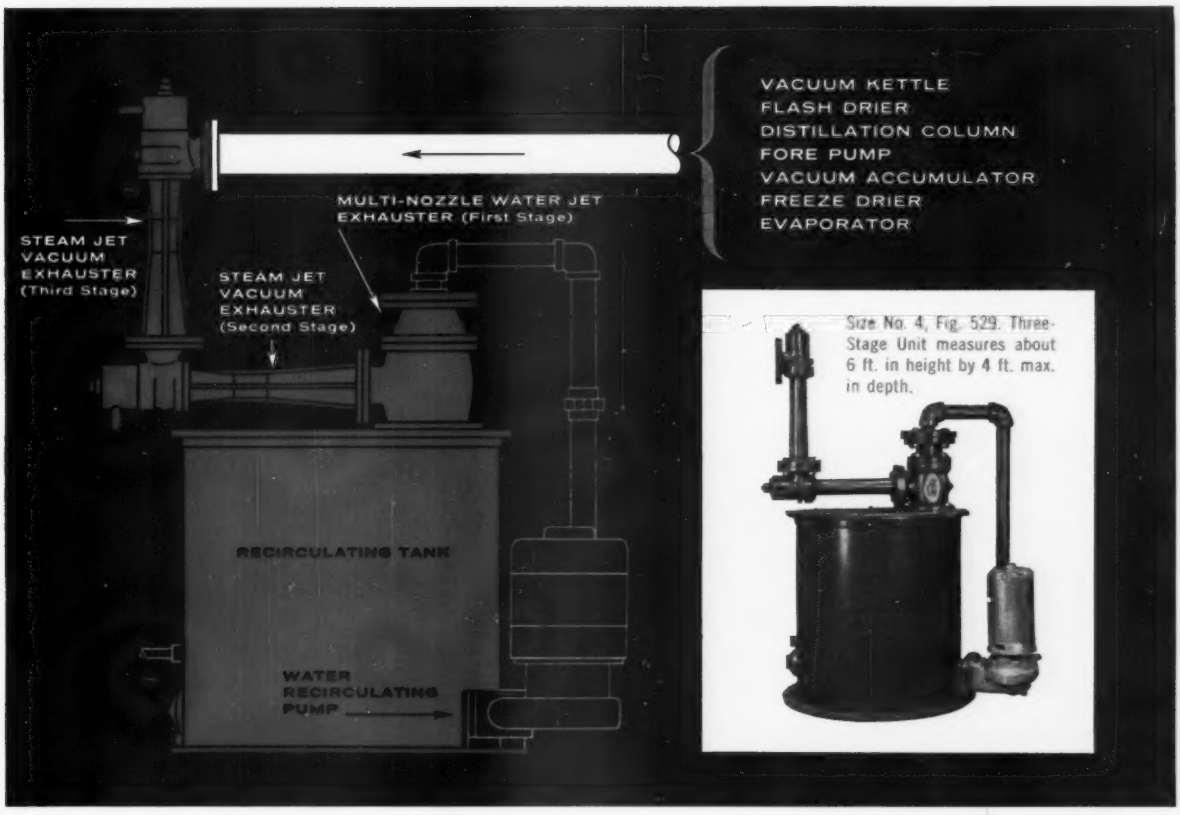
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RECIRCULATING TANK
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Size No. 4, Fig. 529. Three-Stage Unit measures about 6 ft. in height by 4 ft. max. in depth.

PRODUCE HIGH VACUUM QUICKLY & ECONOMICALLY

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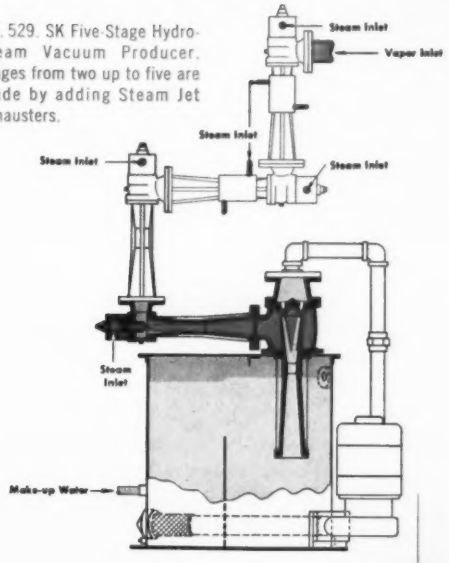

Fig. 529. SK Five-Stage Hydro-Steam Vacuum Producer. Stages from two up to five are made by adding Steam Jet Exhausters.

The unit shown is a "packaged" vacuum producer designed to operate at ground level. Using plant steam and make-up water, it will produce the low suction pressures required for many operations in chemical, food, and petroleum processing plants.

These units are made in a range of sizes in single-stage, two, three, four, and five-stage types. Depending upon size and type, units in this line will provide suction pressures ranging from atmosphere to 1.5 in. Hg abs (single-stage) up to 0.25 mm Hg abs to 25 microns Hg abs (five-stage).

SK "Packaged" Vacuum Producers offer specific, worthwhile advantages. They are simple in construction, are self-contained, compact, require little head room or floor space, are easily installed. Unlike mechanical vacuum producers, contamination presents no problems. They are operated easily, produce vacuum quickly, are economic, can be used intermittently or continuously as desired.

New Bulletin 5H-HS gives complete details on application, construction, operation including suction pressures provided and data on steam consumption and make-up water required. Send for a copy.

JET APPARATUS: Ask for Condensed Bulletin J-1.
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1.
VALVES: Ask for Condensed Bulletin V-1.
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.
GEAR PUMPS: Ask for Bulletin G-1.

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only their time and design. People abroad will be asked to put up part of the funds needed for the plant development program.

Once a plant is planned by engineers and ready to be constructed, funds can be obtained through the Development Loan Fund and other international lending organizations, he said. These organizations are ready to make loans for worthwhile free enterprise projects abroad.

Associated with Webster is William D. Lee, vice president of the new company, a Columbia University graduate. Lee, who spent some time in China, published a Chinese-American newspaper in Shanghai.

Latin American Roadblock

The Castro Government in Cuba has thrown a tremendous roadblock in the path of Latin American countries as far as private investments are concerned. Both officials in the Executive Branch of the government and members of Congress agree that the seizures of United States owned properties in Cuba by Premier Fidel Castro and his government has scared off many millions of dollars of potential private investments in various Latin American countries.

The truth is, American capital is not likely to be invested in countries that have no respect at all for the rules of international law. This is expected to be discussed fully in the next Congress.

Meantime, a very simple question is being asked on Capitol Hill: Why should our citizens be encouraged by our government to invest capital in foreign countries such as Cuba when there is a heavy risk of the properties being confiscated without satisfactory arrangements for full compensation?

Opportunity in Colombia

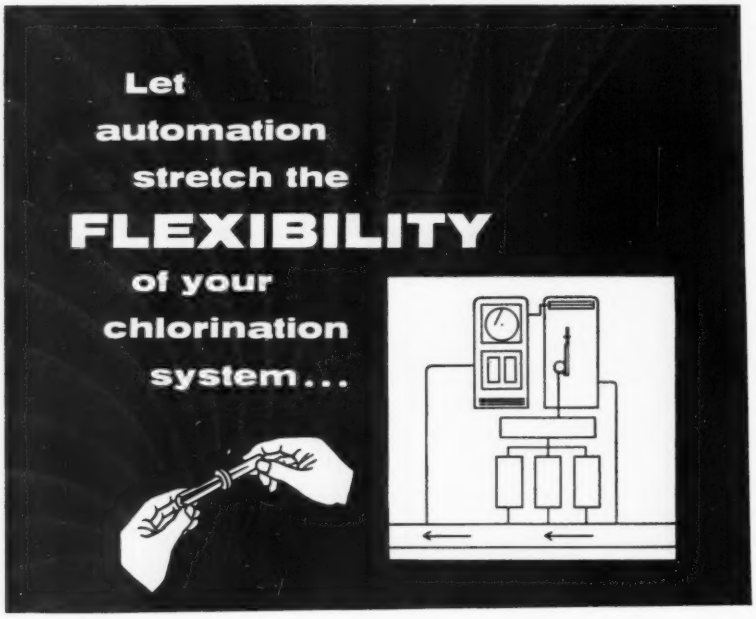
Allocation of $70 million earmarked for road building, municipal waterworks, rural settlement, agricultural development, and urban home financing programs has been made to the Government of Colombia by the Export-Import Bank and the Development Loan Fund.

A $45 million Export-Import Bank credit to the Colombian government is available to finance the acquisition of United States equipment and material, and for engineering and other services required for the construction of 12 penetration roads into five settlement areas, construction of a national secondary road network, provision of municipal water and sewage facilities, and for importation of agricultural equipment.

Development Loan Fund credits also will be available to aid in a five-year program for locating 50,000 settlers in the five projected settlement areas.

Push for Interstate

The Bureau of Public Roads stands ready to go along with the wishes of the National Association of



W&T COMPOUND-LOOP CONTROL

Compound-loop Control by Wallace & Tiernan maintains chlorine residuals automatically—provides utmost flexibility in arrangement and process control.

Chlorinator feed rate is adjusted by two signals: one from water flow, the other from continuous, automatic residual analysis. Since feed rate is the product of these signals, Compound-loop Control gives you a range of greater than 100:1. No matter how much flow or demand changes, your system always maintains the selected residual.

Regardless of the size, type, or physical layout of your system, Compound-loop Control adapts readily. Electric, pneumatic, or variable vacuum control signals can be used. And you can install Compound-loop Control as a package or convert to it, component by component, as your system expands.

For more information, write Dept. S-145.25

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Around the world, consulting engineers prefer project proven American equipment that meets their most rigid requirements. Heavy-duty Revolver Cranes (above) have helped build the biggest dams in the world—worked 24 hours a day for years with the dependability that's essential on such jobs. More than three-quarters of a century of "Big-Job" efficiency and experience are built into every American.

For custom built gantry and bridge cranes, derricks and hoists, contact our Engineered Products Division. Its drawing board to construction services are available to consulting engineers concerned with the design of unique and specialized materials handling equipment. Write for specific facts on the complete American line—machines for every job, from excavation to erection to maintenance

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for wire rope-chain

Country Officials who are on record in favor of completing the 41,000-mile Interstate, multilaned highway system "not later than 1972."

The National Association of County Officials expressed its wishes in a policy platform adopted at the sliver anniversary meeting. Officials of the Public Roads Bureau express the hope that the deadline can be met. Much depends on Congress, the next president of the United States, and the economic conditions of the country, said a spokesman.

FPC Raps Private Power

A group of 76 electric utility companies feel that they have been given a harsh rap by the Federal Power Commission. It has ordered them to reclassify their accounts to reflect the cost of certain advertisements as miscellaneous income deductions rather than as operating expenses.

It is the principle of the FPC directive that the privately owned utilities dislike. The Federal Power Commission ruled that the companies' expenditures for eight advertisements which appeared n 1957 in national magazines are "political in character" and should be classified as income deductions. The series of advertisements were published as a part of the electric companies' advertising program under the sponsorship of "America's Independent Electric Light and Power Companies."

The companies treated the ads as operating costs. Total cost of the questioned advertising was estimated at $863,130. Hearings were conducted in which the Federal Power Commission said, in effect, that the utility companies were taking cracks at the public power companies in their advertisements. This evoked a hassle. The private power companies — those owned by stockholders — maintained that their evidence justified the accounting classification and contended that the proceedings should be dismissed. However, the Federal regulatory agency upheld the examiner and thus overruled the protest of the 76 companies.

Boggs Bill

Congress adjourned the post-convention session without taking action on the Boggs proposal which was pending on the House side of the Capitol. Rep. Boggs' proposal would correct an unfair internal revenue regulation. His bill would remove the existing Federal tax penalty on lobbying and on advertising which is run in connection with lobbying.

The internal revenue code allows as a deduction "ordinary and necessary expenses in carrying on any trade or business." Just what is covered by "ordinary and necessary" is frequently debated. The act specified that salaries, traveling expenses, and rentals are included. Beyond that it is a matter or argument between taxpayers and the in-

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FRONT ACCESS PANEL STAINLESS STEEL
2" K.O. BOTH SIDES
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THESE ROUGHING DIMENSIONS MAY VARY ½ PLUS OR MINUS
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WALL RECESS METAL FORMS for Haws Fountains... provide the exact required opening, access panels, knock-out holes, etc., for simple, efficient, economical installation. Install HAWS special metal "CAN" form in the unfinished wall, and the recessed fountain fits snugly and securely. Write for detailed specs on all HAWS recessed models, with special metal forms. Write today.

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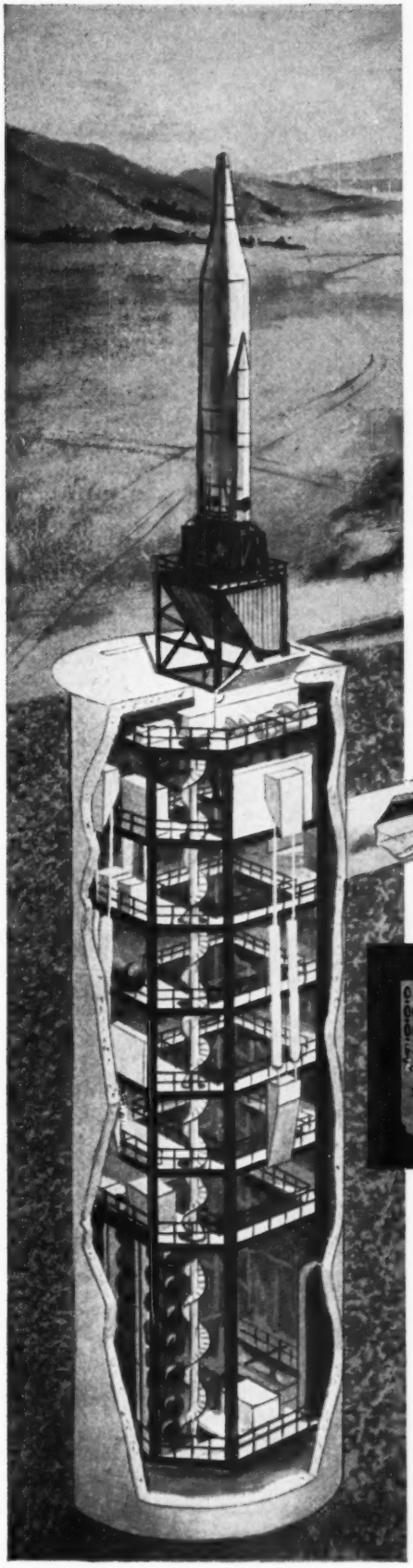
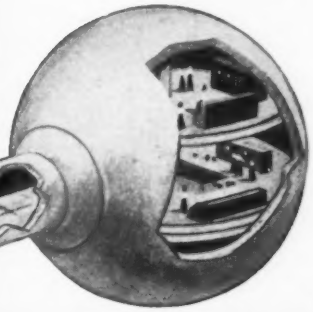
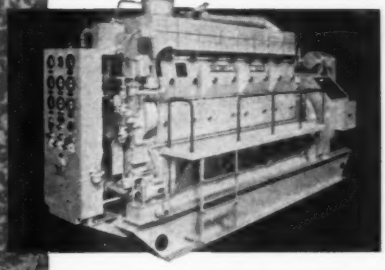


WHITE SUPERIOR ENGINES selected for ATLAS launching sites!

At USAF Atlas launching sites throughout the United States, prime and standby power will be supplied by White Superior engines! The Army Corps of Engineers, Kansas City, Missouri, has purchased 149 eight-cylinder supercharged Model 40 Superiors, each driving a 500 KW generator. These engine-generator sets will produce precise frequency for operation of computers and other electronic equipment. Six of the 13 planned Atlas ICBM squadrons will feature underground silo-type launching sites. Here an additional task for the Superiors will be powering elevator machinery to lift the 120-ton ICBM's to ground level, after they have been fueled and checked out down under.





White Diesel

Superior ENGINES ATLAS Imperial DIESEL ENGINES White DIESEL

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY
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The contract for 149 Superiors highlights a growing and impressive list of Superior-powered U.S. defense installations. Included are the "Texas Towers," portions of "DEW" line and "SAGE" project, Eglin Gulf Test Range and other missile tracking ranges, and numerous launching sites for other types of missiles. Acceptance of Superior engines for these assignments is convincing evidence of their rugged dependability, trouble-free performance and economical fuel consumption. Superior engines—215 to 2150 HP or 150 to 1500 KW—will also meet your exact power requirements, including automatic, unattended or remote controlled operation. Write for complete information today!

USAF artist's conception of Atlas underground silo for launching missiles

ternal revenue service, and requires ultimate definition by the courts.

It has long been an issue whether or not contributions by businesses for political purposes are deductible. In 1959, after a far-reaching Supreme Court decision, the internal revenue Service adopted the regulation which is currently in effect. It provides that expenditures for "lobbying purposes for promotion or defeat of legislation (including the support or opposition to any candidate for public office) or for carrying on propoganda (including advertising) related to any of the foregoing purposes" are not deductible.

It further provides that dues are not deductible if they are paid to an organization (including trade associations which engage in lobbying and similar activities) as a "substantial part" of their activities. The construction provides the right of petition. Lobbying is so held.

The term "lobbying" and "propoganda" are held to be vague. They must be interpreted by the internal revenue service. Rep. Boggs insists that this in effect gives the IRS power to censor through taxation. The provision relating to trade associations places both the associations and their member's businesses in a very difficult position, the Congressman declares.

The proposal that he expects to push at the next session would include as business expenses "expenses lawfully incurred in supporting or opposing or otherwise influencing legislation in the Congress or in a state legislative or local government agencies." Such a measure, if it should become law, would overrule the present IRS regulation. At the same time Boggs maintains it would restore to all businesses their freedom to speak out for or against any legislation affecting their business.

The House Ways and Means Committee reported the bill out of committee unanimously, but it got sidetracked before the July political conventions. The AFL-CIO is against the Boggs bill, and apparently will be ready in 1961 to actively fight it.

Black Fox Not Ready

The Federal Housing Administration is informing engineers who have inquired about the "Black Fox" that the device is not yet available, nor is it in quantity production (see COSULTING ENGINEER, August 1960, p.50).

A spokesman said, however, that when details have been negotiated with the manufacturers, it will be made available not only through Federal Housing Administration offices, but also commercially.

Interstate Progress Report

There are now about 9150 miles of the 41,000-mile national Interstate highway system open to traffic, the Bureau of Public Roads reports. Construction is under way on another 4700 miles. ▲▲

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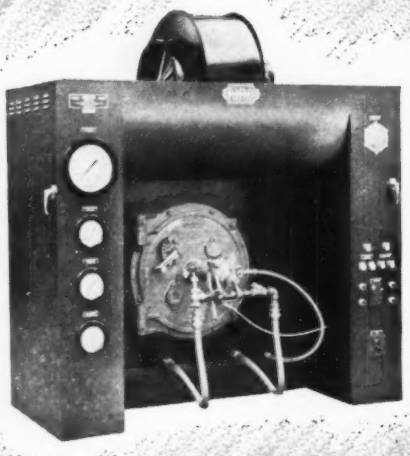

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FULLY AUTOMATIC OR SEMI-AUTOMATIC . . . this high efficiency system is manufactured in a wide variety of sizes and models, arranged for firing steam boilers and high temperature hot water generators of all types up to the equivalent of 100,000 lbs. of steam per hour. Available with axial flow blowers or centrifugal blowers fitted with electric motor or steam turbine drive as required.

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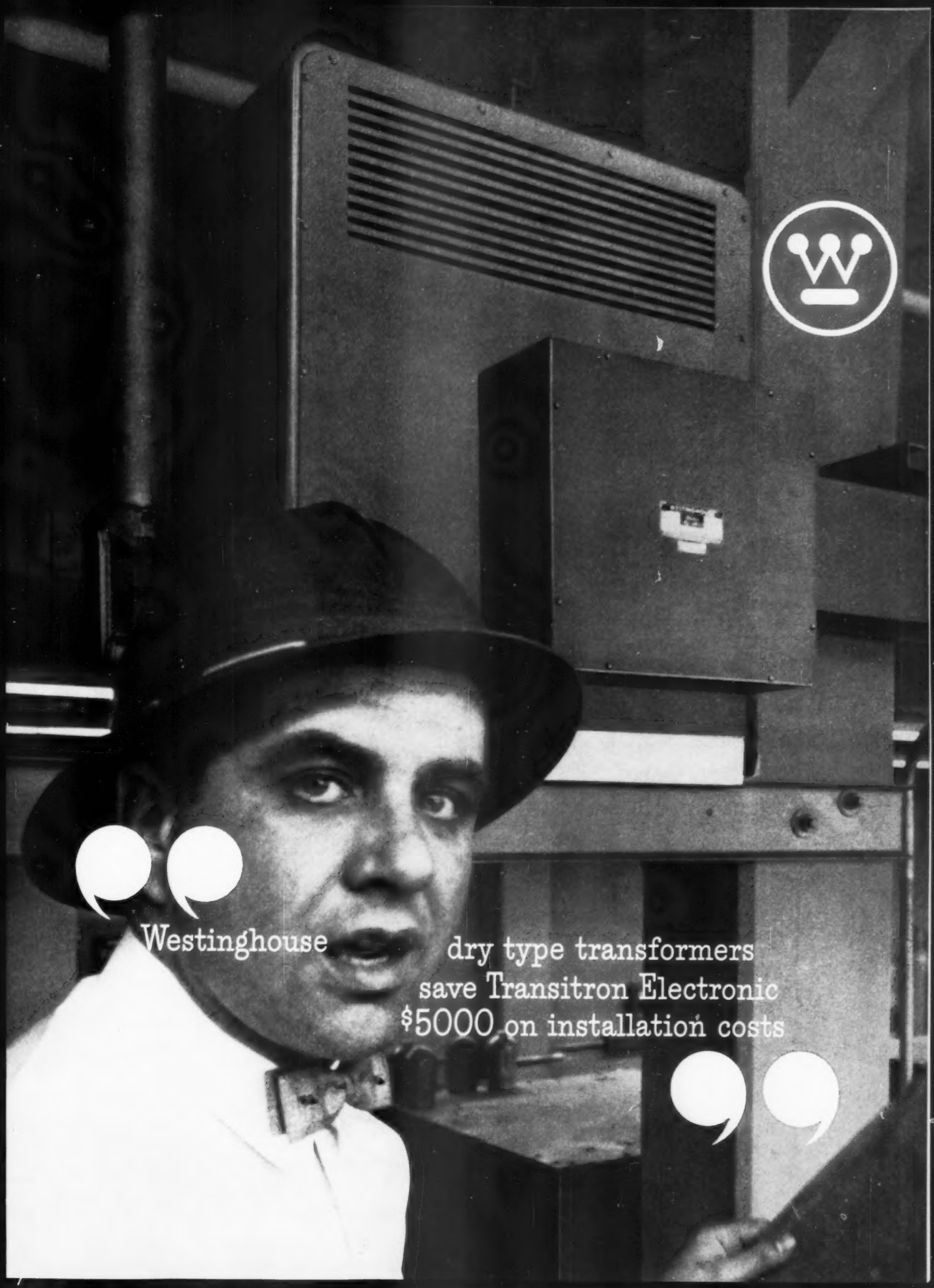

"Westinghouse dry type transformers save Transitron Electronic $5000 on installation costs"

Growing rapidly since its founding in 1952, Transitron Electronic Corporation, now operating in three plants with a total footage of over 750,000 square feet, manufactures transistors, diodes, rectifiers, voltage regulators, controlled rectifiers and 4-layer switching devices. The modern distribution system serving Transitron's new plant—a renovated textile mill—includes 10 Westinghouse DT-3, 300-kva transformers. Plant Engineer H. R. Hammond (on cover) pinpoints how they saved Transitron over $5000 on installation costs.

"Weighing only 1800 pounds each—about 40% less than a conventional unit—the DT-3's were mounted 10 feet off the floor on simple channel irons between building support columns.

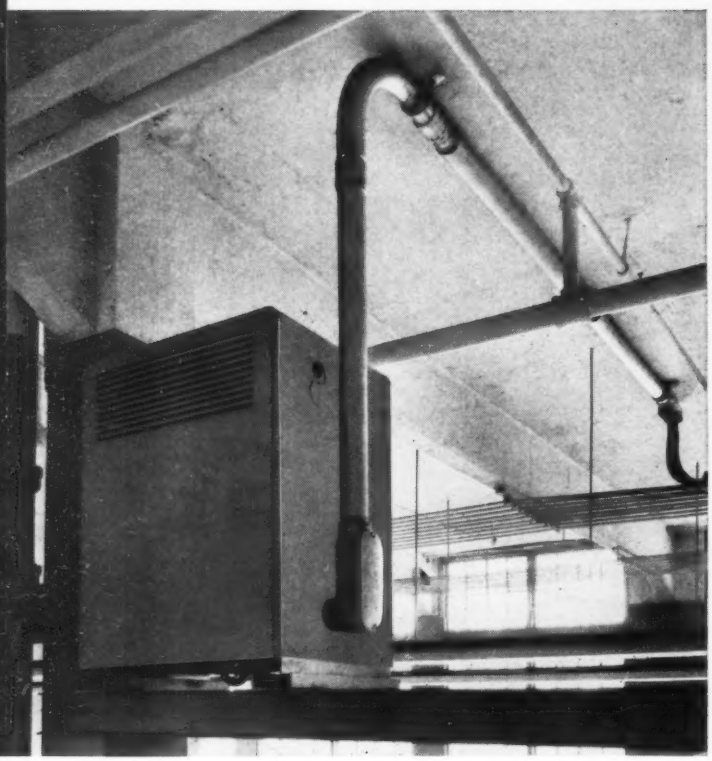
"At $20 a square foot, this saved us $1266 worth of floor space—not including an allowance for service area which would bring the saving to $4000. Since reinforced structural supports were not needed, we saved $40 on support material per unit.

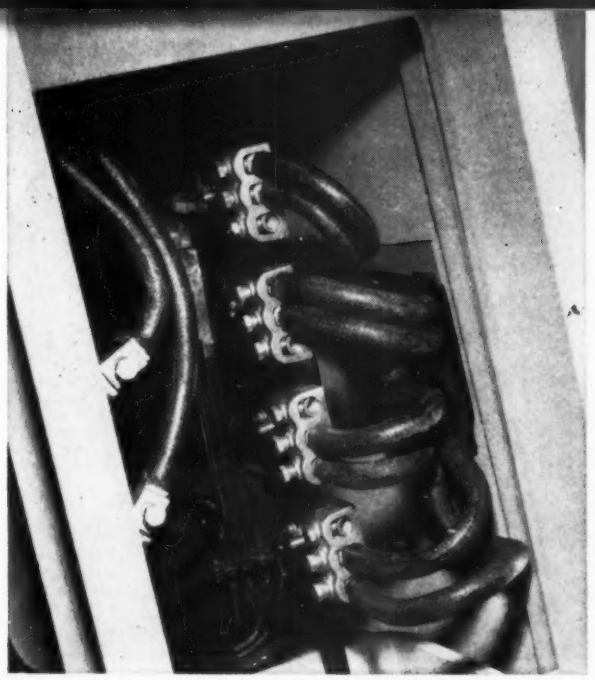
"That's not all. The Westinghouse transformers were quickly positioned with a fork lift truck. Hoisting heavier types would have required rental of extensive rigging equipment, plus 16 man-hours apiece at $68 per day.

"Because of the transformer locations, 15 feet of 7-500,000 circular mill cable were eliminated. At $150 for cable, $50 for conduit and fittings, and $34 for labor, we realized a saving of $234 per transformer, or $2340.

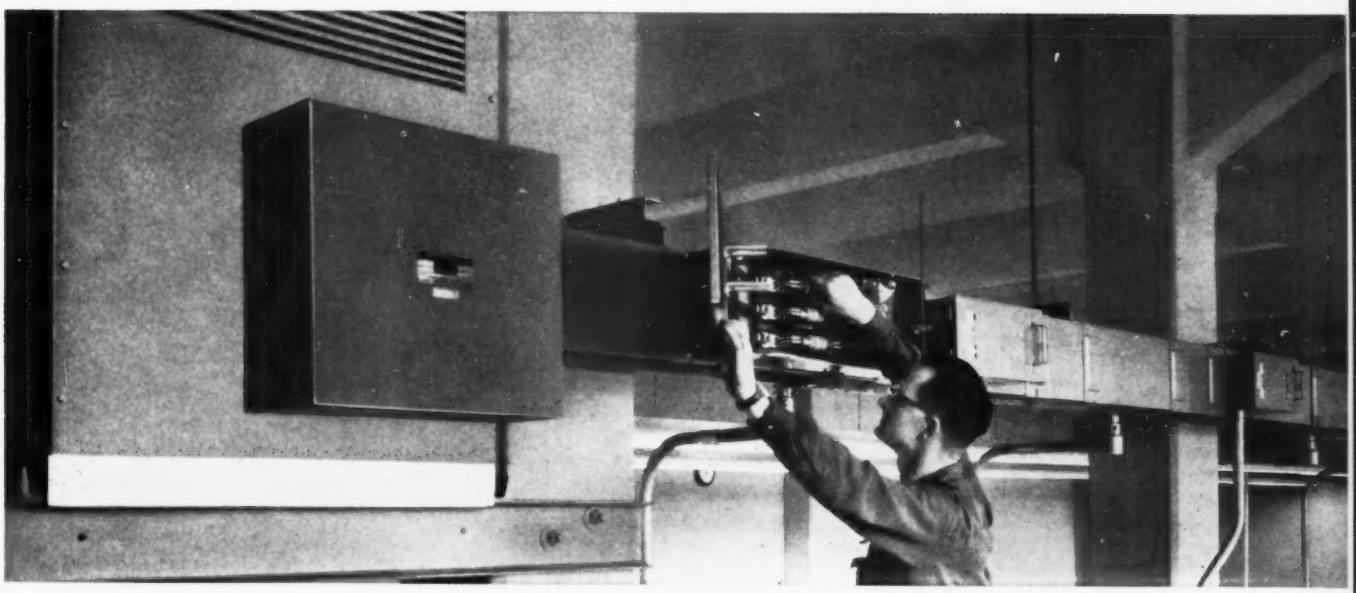
J-70951-2

"Our savings stem from the lightweight, compact size and special features of Westinghouse DT-3 Transformers"





"In addition, terminal compartments at the transformer bottom meant no extra insulation to withstand heat rise so we achieved a 60% saving. Since the transformers came with built-in shock mounts, we did not have to add them at an estimated total cost of $320.

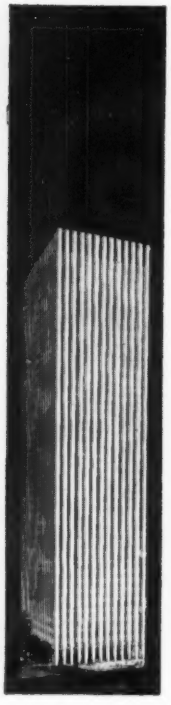


"Connected to the transformers is Westinghouse bus duct up to 70 feet long. Three lines leading through the duct deliver capacities of 1000 amps for production. The duct was easily tapped where necessary to put power where it's needed."

Only Westinghouse dry-type transformers guarantee you substantial installation savings. Check your nearby Westinghouse representative for details . . . or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse. J-70951-3

Westinghouse

F I R



Owner: United of America Building, One East Wacker Drive, Chicago, Illinois. Architects and Engineers: Shaw Metz & Associates, Chicago, Illinois. General Contractor: A. L. Jackson Company, Chicago, Illinois. Steel Fabricator and Erector: American Bridge Division, United States Steel.

ST USE MAN-TEN (A 440) HIGH STRENGTH STEEL IN A SKYSCRAPER SAVES $45,000!

The three basement floors and the first 23 floors of the 40-story United of America Building, Chicago, which will be the Home Office of the United Insurance Company of America, will have USS MAN-TEN (A 440) High Strength Steel 14" WF columns. These will range in weight from 426 to 158 pounds per foot. The remaining columns above the 23rd floor will be structural carbon steel, ASTM A-7, 14" WF's ranging in weight from 287 to 78 pounds per foot.

When compared to a design using structural carbon steel throughout, the design using high strength steel in the columns up to the 23rd floor resulted in a weight reduction of approximately 800 tons of steel and savings of about $45,000 in the cost of the entire erected frame.

The decision to use high strength steel up to the 23rd floor only was based on consideration of deflection limitations.

The use of USS MAN-TEN (A 440) High Strength Steel reduced the depth and weight of the columns and eliminated the need for cover plates on many of them, thus reducing fabrication costs. Architectural details were simplified and considerable space was saved around the columns.

Total steel used: 2,300 tons of USS MAN-TEN (A 440) Steel; 3,915 tons of ASTM A-7 Structural Steel; 88 tons of high strength bolts: Grand total 6,303 tons. The 2,300 tons of MAN-TEN (A 440) Steel did the job that would have required 3,100 tons of A-7 Steel. Thus, there was a weight saving of 800 tons in these columns or 25.8%. When weight savings exceed 16%, it is usually more economical to use USS MAN-TEN (A 440) High Strength Steel.

Up to ¾" thick, the minimum yield point of USS MAN-TEN (A 440) Steel is 50,000 psi . . . with somewhat lower values for thicker sections, yet still higher than structural carbon steel. It is well suited to bolted and riveted construction and has been widely used to save weight in bridges and construction equipment. For welded construction, USS TRI-TEN High Strength Steel is recommended because of its superior welding properties and equally high strength. For more information, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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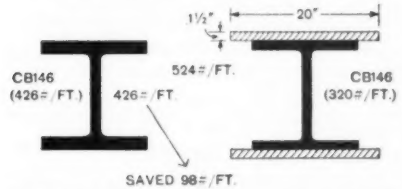
How weight was saved on first four stories.



(Left) USS MAN-TEN Steel. An interior column from 3rd basement. Simple 14" WF section (CB 146) weighing 426 pounds per foot. It was possible to omit cover plates on 50% of all columns.

(Right) If ASTM A-7 Steel had been used, 14" WF section (CB 146) weighing 320 pounds per foot would have needed reinforcement of two cover plates 20 inches wide x 1½ inches thick. Total weight 524 pounds per foot. High strength steel saved 98 pounds per foot.

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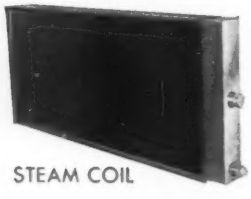
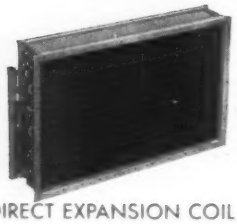
Architect: Lionel K. Levy, New York
Structural Engineer: Dr. Jacob Feld, New York
Contractor: Jas. H. Martin, Incorporated, New York

WATER COIL



STEAM COIL



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Rugged, dependable Bohn coils were used for *two complete air conditioning systems* installed in the modern new Clubhouse Addition at Yonkers Raceway, Yonkers, New York.

Three Bohn 6-row chilled-water coils of the double circuit copper-fin type with a total face area of approximately 70 sq. ft. provide a 40,000 C.F.M. system with a cooling capacity of 2,572,000 BTU/HR, while four Bohn 1-row steam distributing coils with a face area of nearly 42 sq. ft. have a heating capacity of 1,296,000 BTU/HR.

In the second system of 46,000 C. F. M., there are six Bohn 6-row chilled-water coils of the full circuit type with a face area of almost 81 sq. ft. and four Bohn 1-row steam distributing coils with a face area of 48 sq. ft. The cooling capacity is 2,330,000 BTU/HR and the heating capacity is 1,490,000 BTU/HR.

BOHN *KNOWN-CAPACITY* COILS feature . . .

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- Tested and rated according to ASHRAE standard 33-58.

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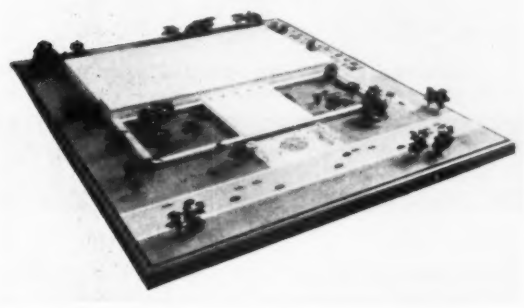
Reporting

The New Projects

Yardley of London Builds New U. S. Plant

Yardley of London, Inc. is building a new $3 million plant in Totowa, New Jersey. Designed by world famous American architect, Edward Durell Stone, the project incorporates three distinguishing features – the affinity of the design to the surroundings, the imaginative use of gardens and pools, and the development of unusual lighting effects. Consulting engineer for the project is Engineers, Inc., Newark.

The 236,000-sq ft building will accommodate all of the company's present facilities at Union City, New Jersey, and will also provide for a 50 percent increase in production capacity. The all masonry, steel frame building will be faced with white brick. It will be set back from the main road by an expansive, paved plaza, centered with an oval garden and fountain. Manufacturing facilities for all types of toiletries will be located off-ground on the second story. Both the manufacturing and administrative sections will be air conditioned. A 5000-sq ft air conditioned garden hall with sky domes and interior gardens will be provided as a lounge area for employees.



Consulting engineer for new Yardley of London plant at Totowa, New Jersey, is Engineers, Inc. of Newark.

Wet Air Oxidation for Wheeling Sludge

The new treatment plant being built by the Wheeling, West Virginia Sanitary Board was designed by Greeley and Hansen, Chicago consulting engineering firm for an estimated 1975 average daily flow of 26.2 mgd. It will remove screenings, grit, and floating and settleable solids from the sewage of an estimated 75,000 people, and will also handle a heavy load of industrial wastes. The plant effluent will be disinfected with chlorine.

Considerable study was given to alternate methods of sludge disposal and their relative total annual costs. The number of alternate methods studied was finally reduced to sludge thickening, sludge digestion, elutriation of digested sludge, vacuum dewatering of the digested, elutriated sludge, and hauling the dewatered sludge to a dump; or sludge thickening, with disposal of the thickened sludge by wet air oxidation.

Selection of the wet air oxidation process was finally made on the basis of relative total annual cost and space requirements for the process.

The wet air oxidation unit at Wheeling is designed to process 5.6 tons (dry basis) of sewage sludge and scum per 24 hours continuous operation. The sewage sludge and scum are to contain not less than 6 percent solids, with not more than 35 percent of such solids being ash. The sludge and scum are to have a chemical oxygen demand of not less than 82 grams per liter nor more than 90 grams per liter, as determined by the Chromate Method. The process is designed to operate at a temperature of 600 F and 1200 psig. After start-up priming, it will generate sufficient power to be self-sustaining.

The contract for furnishing and installation of the wet air oxidation unit was awarded to The Sterling Drug Company in the amount of $284,000. The cost of auxiliary equipment furnished by the Board is not included in this amount. In addition to this sum the Board will pay to The Sterling Drug Company for 15 years certain, a royalty at the rate of $3.00 per ton of sewage sludge and scum (measured on a dry basis) entering the unit.

Because this type of sludge treatment is new and comparatively untried, Greeley and Hansen at-

tempted to write the contract specifications in such a manner as to afford the Board the greatest security possible should the unit fail to perform according to specifications. This was covered in great detail in the specifications for the acceptance tests and the performance guarantees.

Century City Moves Ahead

Webb & Knapp, Inc. and Aluminum Company of America have joined forces to create the model "city of tomorrow" on a California movie lot. When completed, Century City will represent the largest privately financed urban development in the U.S.

A new design concept of structures in aluminum, glass, and other contemporary materials will be featured in the construction which is being master planned by Welton Becket & Associates of Los Angeles.

Downtown Plant for Steam, Chilled Water

America's first utility operated central plant to supply both steam for heating and chilled water for cooling will be built in downtown Hartford, Connecticut this fall. The $3 million structure will be ultra-modern in design and will be erected primarily to serve the commercial buildings now under construction in Hartford's $50 million urban renewal project – Constitution Plaza. Consulting engineers for the utility plant are Seelye Stevenson Value & Knecht of New York City, with the F. H. McGraw Company handling the construction. The plant is being built for the Hartford Gas Company.

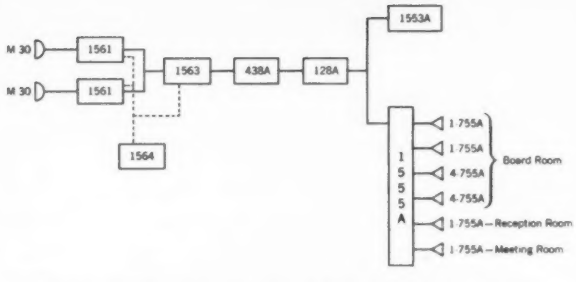
Initially the plant will have a capacity of 100,000 pounds of steam per hour which will be used for both heating and the operation of refrigeration equipment capable of freezing 9000 tons of ice per day to supply chilled water for air conditioning. Charles DuBose, Hartford architect, will make liberal use of modern glass and ceramic products in the 200-ft long structure. It will actually consist of two buildings connected by a walkway; one will house the boilers and chilled water equipment, while the other will house the control room and offices.

Prestressed Concrete County Bridges

Because they often lack adequate maintenance crews, county officials are showing a growing interest in prestressed concrete bridges. In addition to reduced maintenance costs, they are also finding that prestressed concrete can give low first costs.

Frederic A. Nassaux & Associates, of Chambersburg, Pennsylvania, recently designed a prestressed county bridge for Franklin County, Pennsylvania. Alternate bids were taken for prestressed box beams, prestressed composite I beam construction,

Riggs National Bank Sound Engineer* specified ALTEC



Altec System in (60-seat) board room of Riggs National Bank.

Founded in 1836, Riggs National Bank is not only the largest but one of the oldest in the nation's capital. In keeping with management's belief in the value of experience, sound engineers for the bank chose reliable ALTEC equipment for its sound system. Throughout the world—for public and private institutions, auditoriums, stadiums, hospitals, schools, churches, shopping centers, for government, commercial and industrial buildings—engineers and architects depend on the sound leadership of ALTEC engineered sound products.

Through the years, ALTEC sound systems serve to strengthen your reputation. Because, like all ALTEC products, they're designed for dependable service under all conditions—for longer life, ease of installation and service. There are more than 100 different ALTEC commercial sound components and/or systems available for designs to meet your specifications. Before you specify commercial sound equipment, you'll want to talk to your nearest ALTEC representative. For his address look in the Yellow Pages of your Telephone Directory or write to ALTEC at the address below. See our catalog in Sweet's Architectural file 34/AL; Industrial Construction File 17e/AL, 1960 Edition.

* Shrader Sound, Washington, D.C.

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First National Bank, Ft. Lauderdale, Fla.
Dade National Bank, Miami, Florida
Florida National Bank at Brent, Pensacola, Fla.
First Federal Savings & Loan Bldg., Hattiesburg, Miss.
East Central Branch, Bank of New Mexico, Albuquerque, New Mexico
Bank of Broken Arrow, Broken Arrow, Oklahoma
First National Bank, Muskogee, Oklahoma
First National Bank, Abilene, Texas
First Savings & Loan Bldg., Corpus Christi, Texas
Austin Savings & Loan Co., Austin, Texas
North Austin State Bank, Austin, Texas
Security State Bank, Beaumont, Texas
American National Bank, Beaumont, Texas
Farm-Home Savings & Loan Bldg., Ft. Worth, Texas
Raymondville State Bank, Raymondville, Texas
First National Bank, Rockport, Texas
Bellaire State Bank, Bellaire, Texas
Lockhart Savings & Loan Bldg., Lockhart, Texas
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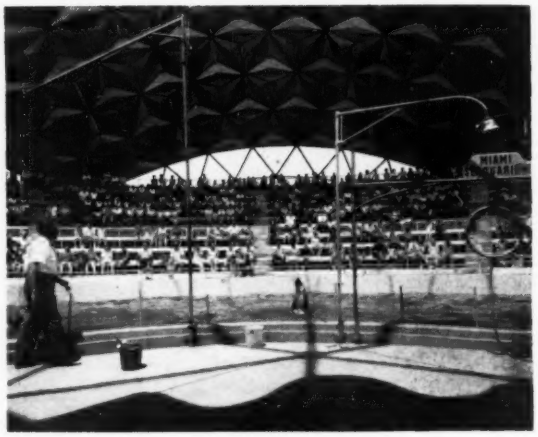
and composite steel construction. In this case the box beam design proved most economical and the entire bridge was built for a cost of $10.73 per square foot.

R. S. Delamater, Wichita consulting engineer, designed a prestressed box beam bridge for Harvey County, Kansas, which cost only $8.08 per square foot. The bridge is 255-ft long with two outside spans of 49-ft and three interior spans of 51-ft. It is of composite design, with mild steel reinforcing placed over the supports in the concrete topping to make the bridge continuous for live load. The box beams rest on Neoprene bearing pads. Piers are prestressed concrete pile bents.

Geodesic Dome Forms Sun Shade

The Miami Seaquarium gold-anodized geodesic dome is probably the first to be used as a sun shade for an outdoor audience. The structure is a half shell composed of struts of aluminum channels, between which creased diamond-shaped aluminum panels are sandwiched. Panels are inserted only in that segment of the dome which arches over the audience, and are omitted to the southeast and northwest to allow light and breeze to pass through. Since the huge roof is not intended to shelter the audience from rain, there is a half-inch gap between panels, allowing an interesting play of light.



Miami Seaquarium has installed a gold anodized geodesic dome as a sunshade for its outdoor audience.

Robert Richter, of Kaiser Aluminum and Chemical Sales Company, had to devise a new method of approximate analysis for this unique dome. He superimposed the effect of the normal geodesic dome design upon the design of a two-hinged arch for that portion of the great shell that is enclosed. Donald Richter, also of Kaiser, had to devise special erection techniques for the dome since it was

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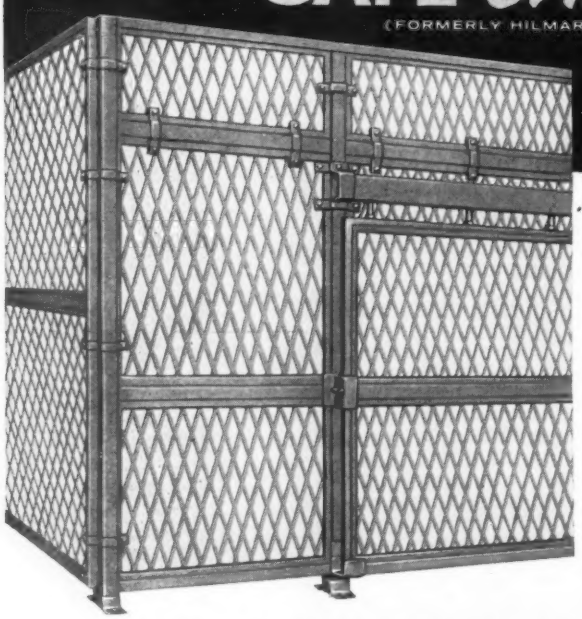

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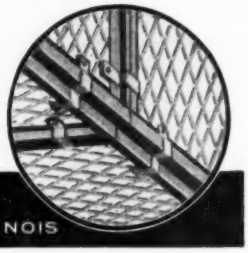
Here is the new, easier, simpler method of guarding conveyors and machines and for all in-plant partitioning. Shipped READY for erection, no cutting, drilling or welding required . . . these interchangeable expanded metal panels provide greater safety, cut overall costs, cover a wider range of use and require 85% less storage space.

EXCLUSIVE QUIK-ERECT SECTION CLIPS save much of the erection time formerly required. Proven successful in hundreds of installations, these Safe·Gard panels are of welded construction, give longer life, are more rigid and stronger than wire, will not ravel or fray.



Note enlarged detail showing SAFE·GARD Quik-Erect Clips securely joining the interchangeable panels.

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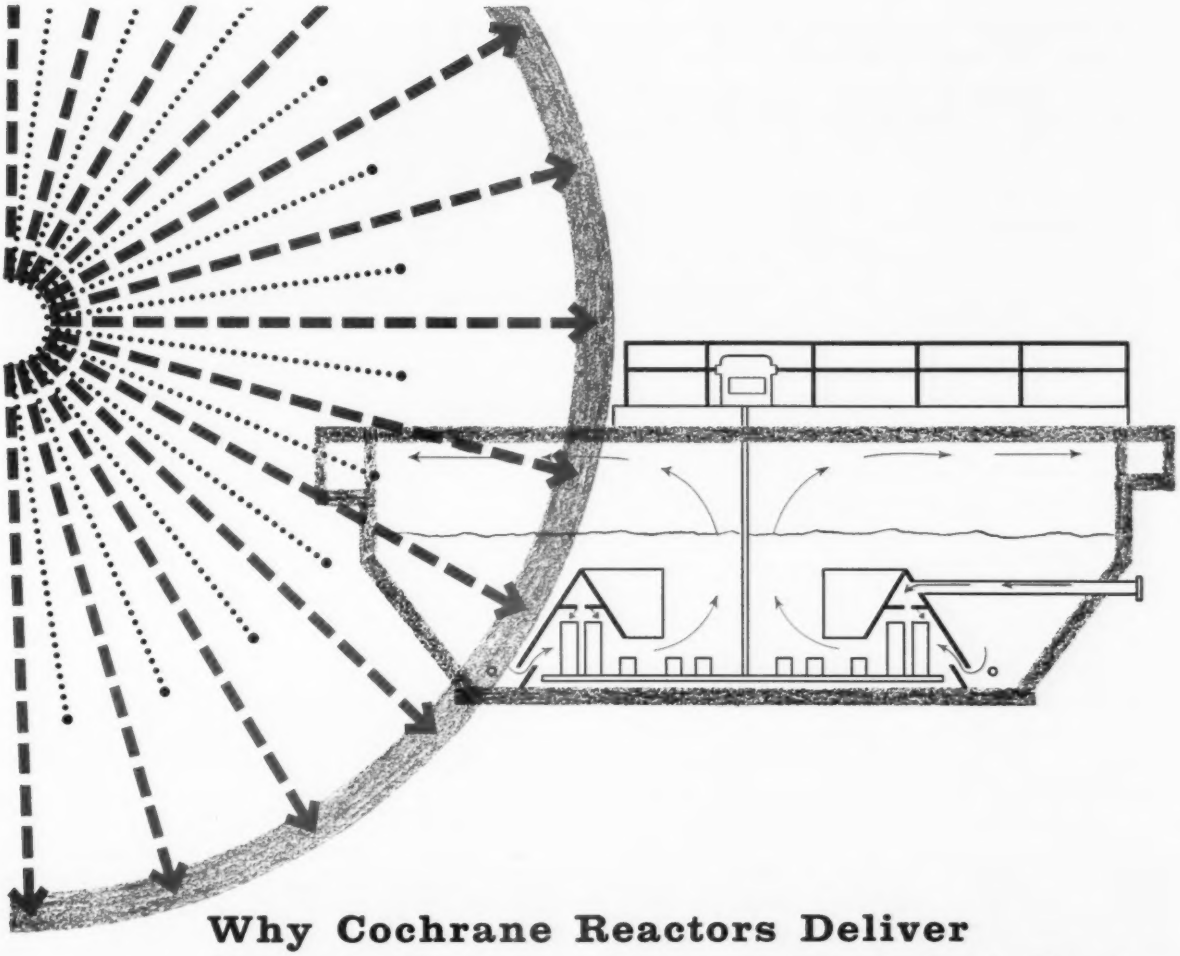

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For more details of Cochrane's exclusive design feature, send for the new Publication 5001-C, "Solids-Contact Reactors". In water softening and coagulating, as in other water conditioning methods, no one has more experience than Cochrane.

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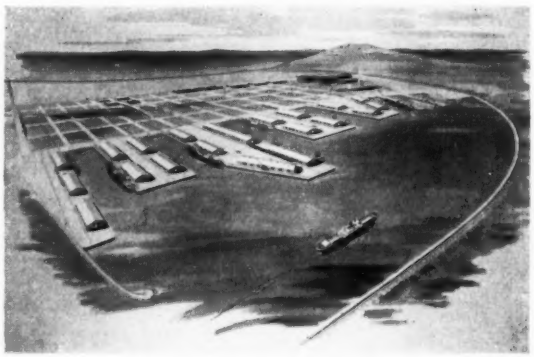
centered over an open pool in which the aquatic anmials at the Seaquarium perform. The 57-ft high, 145-ft diameter structure was raised by two cranes rather than by a central mast, as is more common.

Foundation design for the structure was handled by the engineering-architectural firm of Rader and Associates. They found that the dome was so light that the important factor was uplift stress. Thus, expensive piling was avoided and a spread footing, consisting of a ribbon of reinforced concrete 2-ft thick and 8-ft wide was used. It is buried underground to a minimum depth of four feet and holds the structure down with the weight of earth upon it. Soil pressure under the foundation is only 500 pounds per square foot.

Israel's Ashdod Port Development

Ashdod is located on the southern coast of Israel's Mediterranean shoreline. Its projected port development is on the seashore in front of a new industrial area which will eventually bring the city's population up to 160,000 people. The land area is fairly flat and composed of coarse and fine sand. A field mission of the French Laboratoire Centrale d'Hydraulique de France carried out an extensive and basic beach study at the coast area in 1957-1958, and the study is being continued by the Coast Study Group of Israel's own Ministry of Transport.



Master plan for Israel's Ashdod port development was prepared by Frederic R. Harris, Inc., New York.

The master plan for the port development was prepared by Frederic R. Harris, Inc. It was based on cargo forecasts and on various economic and beach data. It calls for an off-shore development of protected water-shed by means of breakwaters, as well as berthing facilities arranged along wide finger piers projecting into the protected water basin and reclaimed from the sea by dredging.

The plan is divided into two main phases of development: a first complete phase for 16 berths

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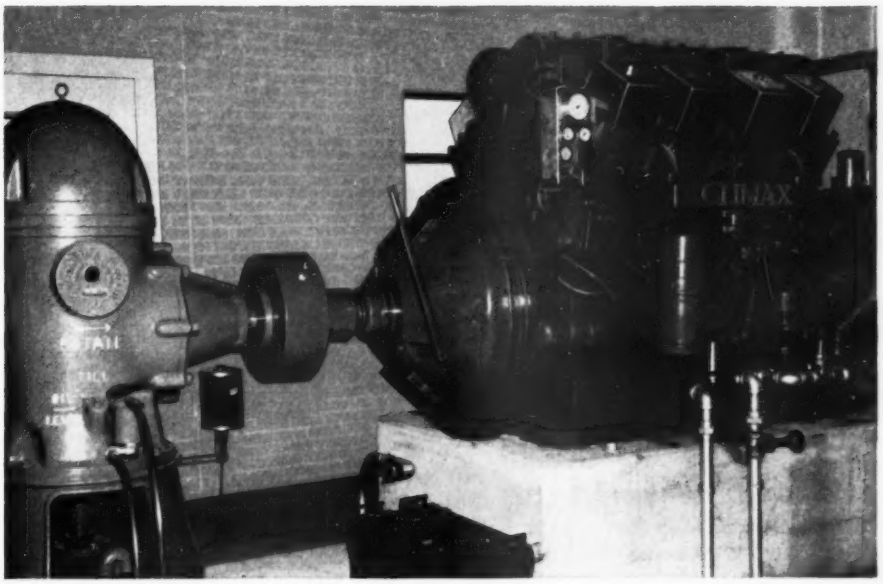
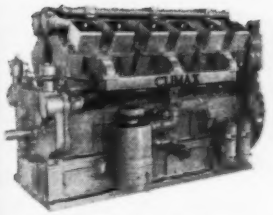
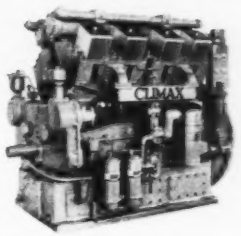
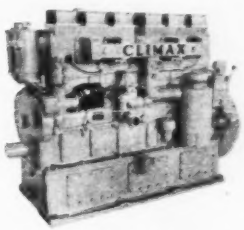




V-125—12 cylinder,
605 max. hp. at 1200 rpm.
V-122—12 cylinder,
520 max. hp. at 1200 rpm.



V-85—8 cylinder,
390 max. hp. at 1200 rpm.
V-80—8 cylinder,
340 max. hp. at 1200 rpm.



K-75—6 cylinder,
304 max. hp. at 1200 rpm.
K-67—6 cylinder,
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IN SEWAGE TREATMENT PLANTS everywhere Climax engines power sewage pumps, blowers and generators. Burning sludge gas, and utilizing heat from jacket water and engine exhaust gas to heat digesters and buildings, they effect big savings. Capable of operation on natural gas, butane, gasoline, or any combination. For continuous duty service in sewage plants—seven rugged Climax models: 12, 8, 6 cylinders.

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BASIC MAX. ENGINE HP (Natural Gas and Gasoline) ①					600	700	800	900	1000	1100	1200
MODEL	No. of Cyls.	Bore and Stroke	Displ.	Torque @ RPM	BRAKE HORSEPOWER AT SPEEDS INDICATED						
R-165	6	6⅛ x 7	1238	930 @ 750	105	123	140	156	170	183	192
K-67	6	7 x 7	1616	1240 @ 805	140	165	188	210	230	248	265
K-75	6	7½ x 7	1855	1410 @ 800	160	186	214	240	265	286	304
V-80	8	7 x 7	2155	1610 @ 850	178	210	241	272	300	323	340
V-85	8	7½ x 7	2474	1860 @ 900	207	249	285	317	345	370	390
V-122	12	7 x 7	3232	2440 @ 900	280	330	380	420	460	490	520
V-125	12	7½ x 7	3711	2880 @ 850	310	370	435	490	540	580	605

① Basic engine includes ignition, maximum carburetion, and water pump. Ratings indicate maximum horsepower.

CLIMAX ENGINE MANUFACTURING CO. • FACTORY—CLINTON, IOWA
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and an ultimate phase for 30 berths. Construction will be scheduled according to the country's port-capacity demand. The first immediate construction stage is being called "Citrus Phase," since its main aim is to enable the export of about 350,000 tons of citrus fruit. It is anticipated that the citrus wharves will be ready for partial use by October 1963 and all construction on the first phase will be completed by October 1964.

Los Angeles Music Center Design

The Los Angeles Music Center design is the result of a two-continent study by the firm of Welton Becket and Associates, architects and engineers. Designed as a pavillion, the Center will feature dramatic fluted columns extending the full height of the building and continuing around its periphery. The building will command a dominant position on the city skyline and will be visible for miles from the surrounding area.

The columns and roof overhang will be formed of precast white stone over steel and the building itself will be faced with dark granite and glass. A wide outdoor promenade will surround the structure at the first and second levels. Decorative lighting fixtures will be suspended from the roof overhang on all sides of the building. Specially designed and formed of glass chips, they will dramatically reflect their light onto the sides of the building. The undersides of the roof overhang will be sculptured into classical type modillions to produce a rich and interesting effect reflecting the dignity of the Greek tradition.

Los Angeles Music Center will occupy dominant position on city's skyline, visible for miles around.

Dimensions of the Music Center are on a grand scale. The building is 330-ft long and 252-ft wide and rises to a height of 92-ft from the first promenade level. Auditorium seating has been planned to give flexibility so that it can meet the require-

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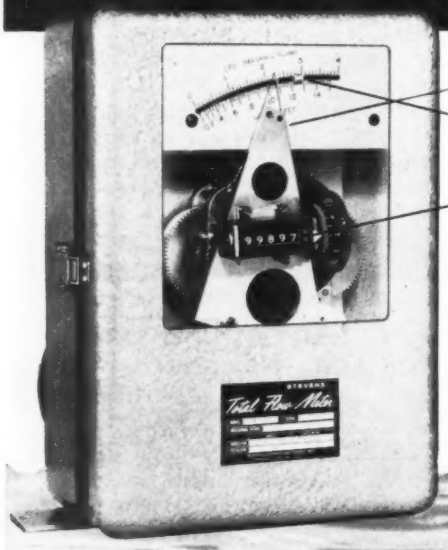
TOTAL FLOW METER
Model 60M



Low-cost meter provides essential flow data for operation of sewage treatment plants

- **INDICATES FLOW**—Rate of flow and head are indicated by pointer and scale.
- **INDICATES PEAK FLOW**—Sliding red index on scale indicates peak flow.
- **TOTALIZES VOLUME**—Counter totalizer registers total flow.

Mechanically operated meter provides essential data in measurement of sewage, industrial wastes, irrigation water or other liquids flowing in open channels. Standard meter gives direct flow reading in cu. ft./sec. and totalizes volume in cu. ft. Readings are easily converted to other units of measurement.

The instrument is designed for use with Parshall flumes and various weirs. It is entirely mechanically operated, will function without attention for eight-day intervals, and is easy to install on table, shelf or wall. If a graphic record is desired, the meter can be used with a Stevens Type F Recorder. Write for Stevens Hydrologic Instrument Short Form Catalog No. 23, and for Bulletin 28 which describes the Model 60M meter in detail.

HYDROGRAPHIC DATA BOOK—Valuable reference file. 124 pages of technical data on recorder installations, plus a wealth of hydraulic tables and conversion tables. $1 copy. (No C.O.D.'s)

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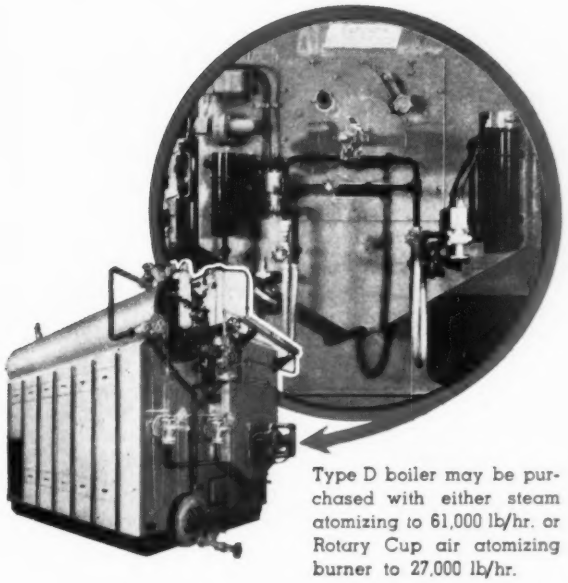
Specialists in hydrologic instruments for over half a century

automatic firing fronts.....

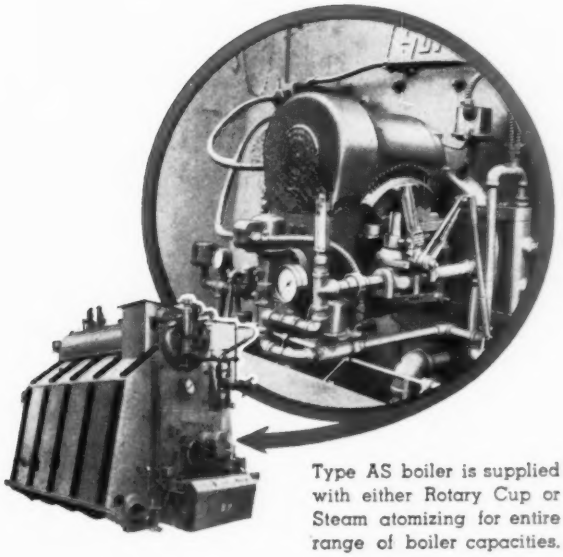
Part of the package *with*

SUPERIOR
PACKAGED BOILERS

for RESIDUAL FUEL OILS



Type D boiler may be purchased with either steam atomizing to 61,000 lb/hr. or Rotary Cup air atomizing burner to 27,000 lb/hr.



Type AS boiler is supplied with either Rotary Cup or Steam atomizing for entire range of boiler capacities.

The efficient firing front of a Superior Package Boiler is much more than a mere burner . . . it is an integrated burner with its associated controls combined with an air register designed to provide proper velocities and turbulence as well as an air-cooled firing front which is both accessible and uncluttered.

Superior's air register itself is unique as a result of Superior's rear-mounted draft fan . . . providing both an air-cooled furnace floor (Type AS) or furnace roof (Type D) and a static to velocity head change which assures undistorted combustion.

Burner equipment is dictated by your operations. *Single steam atomizing burners* are provided for capacities to 46,000 lbs/hr. with positioning or metering controls. For greater capacities, twin burners with metering controls provide an extended range of operation with greater safety.

The steam atomizing burner illustrated, shows shut-off valves, recirculation feed control, fuel temperature control and atomizing steam qualifier . . . neatly assembled at firing front for maximum performance, safety and availability.

Rotary-cup, air-atomizing burners with positioning controls are supplied for capacities to 27,000 lbs/hr. Controls may be in integrated console or separate free standing panel. This burner provides efficient fully automatic operation burning residual fuel oils with supervision.

The rotary burner illustrated is mounted on a forced-draft windbox with triple channel air supply, has self-contained atomizing air fan and automatic fuel temperature control. This arrangement provides maximum flexibility combined with economy and safety of operation.

Their unique firing fronts are but one of the many exclusive features which make Superior Packaged Boilers outstanding in their field. If you'd contemplate the purchase of a boiler, it will pay you to investigate. Write for Catalog ASD-13.

Specialists in PACKAGED BOILERS... exclusively

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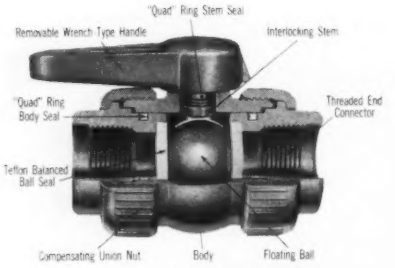
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
PACKAGED BOILERS



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Here's a complete line of plastic valves that *cuts replacement costs and downtime wherever acids, alkalies and many solvents are handled!* Made in 5 basic types of plastics; broad chemical resistance as well as good performance in high temperature ranges.

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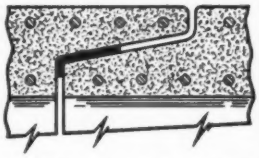
TYLOX "C"

Rubber PIPE GASKETS

. . . provide visual proof of correct pipe coupling

Hamilton Kent Type "C" TYLOX Gaskets for concrete sewer pipe provide watertight joints at head pressures up to 50 feet. Gasket consists of base, multiple sealing fins and *inspection flange* which overhangs the edge of the pipe tongue, or alternately, the tongue offset, according to the type of pipe.



TYLOX "C" Gasket under full compression. Note the visual inspection feature.

"C" Gaskets are of true compression type, made of either rubber or neoprene. They may be installed at the job site, or pre-assembled at the pipe manufacturer's plant. Compounded specially to resist sewerage and industrial waste acids, they never deteriorate. Under ground and under compression, TYLOX "C" Gaskets outlast the pipe itself. Write for brochure.

5140-3

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ments of specific musical events. Capacity will range from 2700 to more than 3100 seats.

Concrete Research and Technical Center

One of the nation's most modern and complete concrete research laboratories is now located in Cleveland, Ohio. Ten years in planning, Master Builders Company's new research and technical center is a fully equipped 16,000-sq ft facility. Heart of the research and technical center is the concrete laboratory where investigations of admixture formulations, cement, aggregates, and mix proportions are conducted. A total of 90,000 pounds of coarse aggregate and sand can be stored in three separate bins which are loaded from outside the building. Bagged cement is stored in a special cement storage room. A specially designed curing room holds temperatures between 68 F and 72 F, at 100 percent relative humidity.

Master Builders Company has opened a new research laboratory designed for expanded studies of concrete.

Electrically Heated School

Reported to be the world's largest electrically heated school, the $2.2 million Johnson City senior high school, in Johnson City, Tennessee, will use aluminum conductor and conduit throughout. The engineering firm of Vreeland and Montgomery, Knoxville, wrote specifications which allowed either copper or aluminum of equal current carrying capacity. Construction estimates indicated an advantage for the use of aluminum.

A connected load of 4209 kw, to seven buildings in the campus-type school, will be carried by 600-v aluminum feeders. Over half the electrical energy will be used to heat areas covering 104,500-sq ft

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REINFORCED CONCRETE

Spanning a river . . . a highway . . . a railroad . . . or other hazards? You can do it more economically with reinforced concrete. Only reinforced concrete offers the cost-saving advantages of unlimited design and construction flexibility for terrain and usage . . . minimum construction time through ready availability of materials and labor . . . lowest structural maintenance. It's more durable, too. Reinforced concrete combines reinforcing steel with concrete to provide the most rugged structure possible.

Concrete Reinforcing Steel Institute
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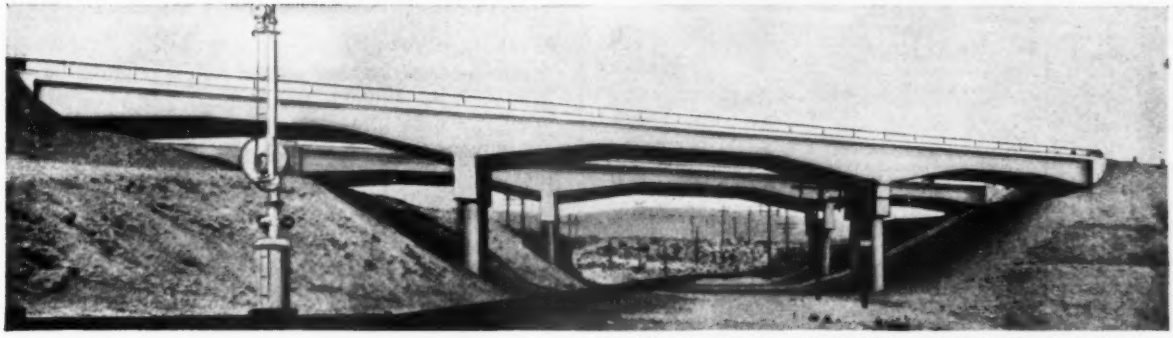
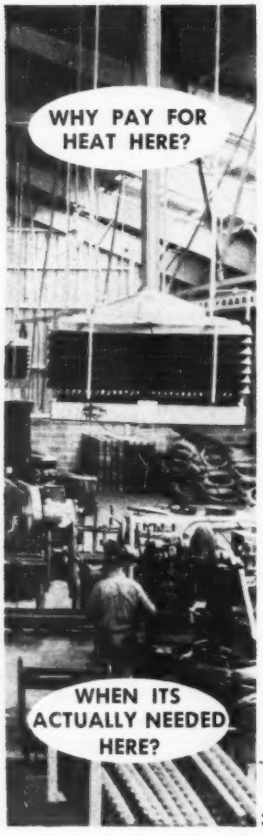
Arch bridge over north fork of Payette River, State Highway 15, Smiths Ferry, Idaho
Designers: Idaho Department of Highways, Boise, Idaho
Contractor: C. F. Dinsmore

"T" girder highway overpass, Interstate Highway 80, Low, Utah
Designers & Engineers: Ken R. White Consulting Engineers, Denver, Colorado
Contractor: M. Morrin & Son Co., Ogden, Utah



Box girder railroad overpass, Interstate Highway 15, south of Las Vegas, Nevada
Designers: State of Nevada Department of Highways, Carson City, Nevada
Contractors: Whiting Bros. Construction Co., Industrial Construction Co., and General Contractors

14-6



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PANELBLOC
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Panelbloc infra-red radiant heaters actually "Heat Like The Sun." Heat waves radiate downward, warming everything in their range — floors, furniture, machinery or people. Panelbloc heats the floor first.

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AMherst 4-5152

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of floor space. Secondary voltage will be 480 - 120/208. The project will require 52,290 feet of aluminum feeders ranging in size from #1 to 500 MCM, and 83,000 feet of aluminum conduit, from ½ inch to four inches.

No Smog in Chicago's Exposition Center

Chicago's $34 million Exposition Center, now under construction, will use 993 Dorex Air recovery and air purification cells to purify air for reuse in the air conditioning system. Serving 350,000-sq ft of exhibition space, the air purification equipment will have a total of almost 1 million cfm recirculated through it. This represents a savings of 800 tons of air conditioning capacity at an installed cost of approximately $360 per ton.

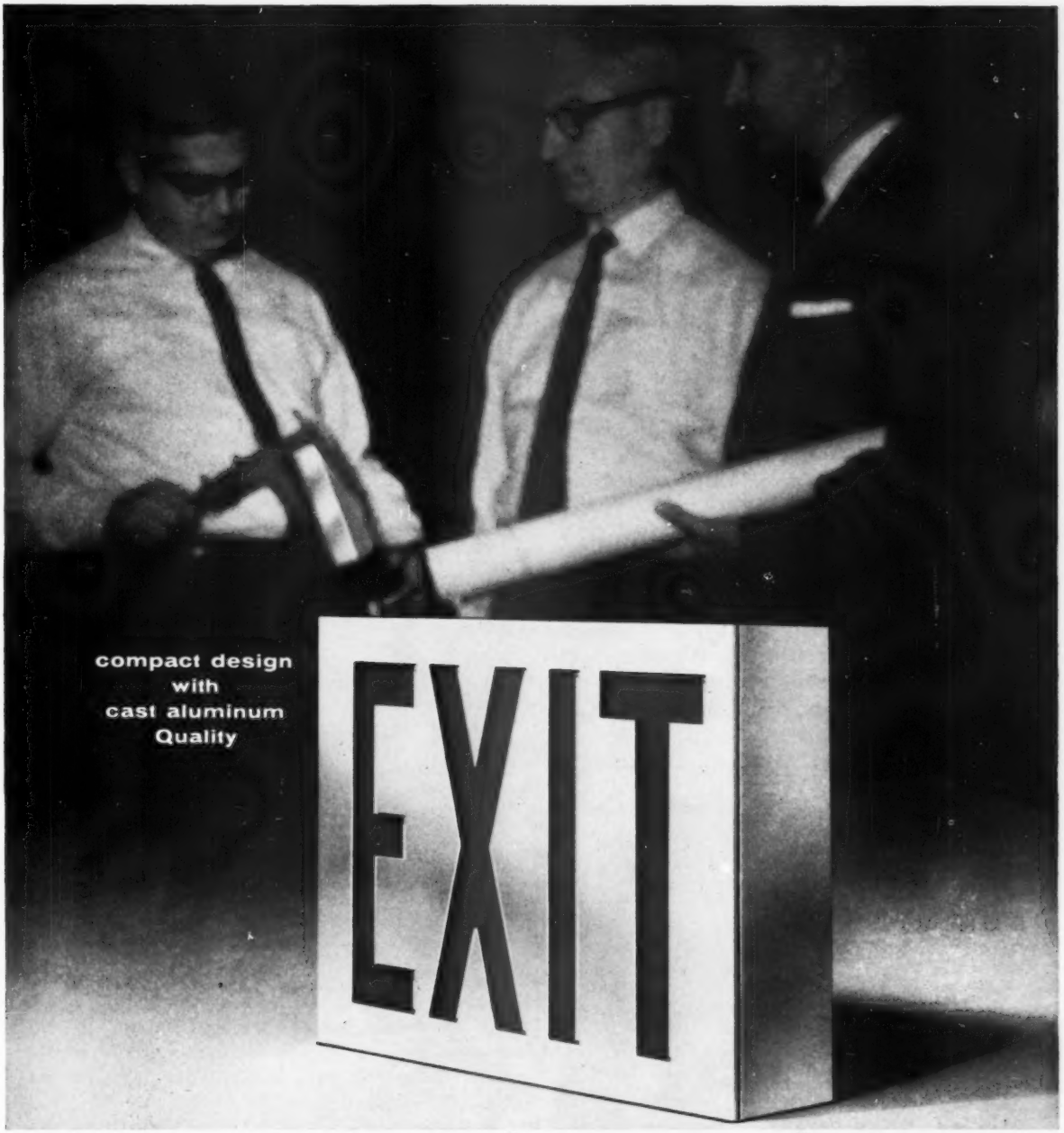
The Exposition Center is the concept of Alfred Shaw, chief architect; and John Dolio, consulting engineer, and Carl Metz, consulting structural engineer. The air purification system which they specified is just one of many features designed to provide maximum physical comfort and convenience for the large crowds which will gather at the lakeside Exposition Center.

Chicago's $34 million Exposition Center will use air purification cells to maintain smog-free atmosphere.

World's Most Powerful Magnet Laboratory

What has been described as the world's most powerful magnet will become part of a new research laboratory to be built at the Massachusetts Institute of Technology under a contract with the United States Air Force. This national research facility will be available for use by groups from academic, government, and research institutions in the United States, and visiting scientists from other nations.

For the past two years, Jackson & Moreland, Inc., of Boston, Massachusetts, has been retained by MIT to prepare preliminary design studies for this



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Contact your mcPhilben representative today for sample demonstration of new 50 line, the most compact and functional, Code Regulated Directional ever produced by any Lighting Manufacturer.

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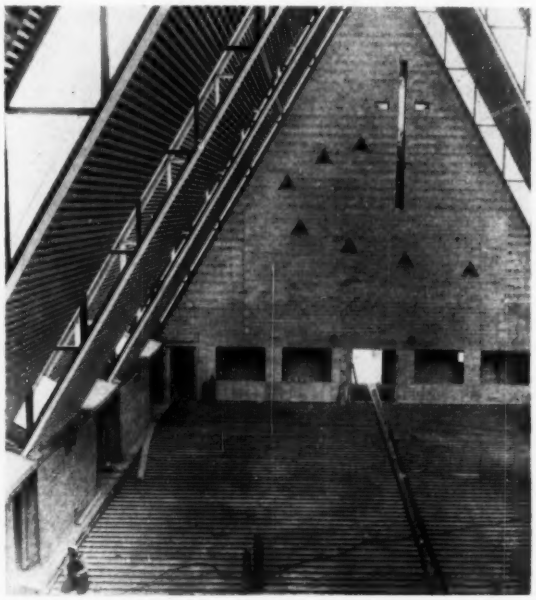
new research facility. Previously, in 1937, Jackson & Moreland worked with Dr. Bitter of MIT on the original high density magnet facility currently in use at the school. Construction on the new and more powerful laboratory is scheduled to start about mid-1961, with full operation by 1964. The cost of the facility is estimated at over $6 million.

Novel engineering solutions will be involved in furnishing large amounts of direct current power and high purity cooling water to the magnets located in eight test cells. The power supply will be capable of furnishing 40,000 amperes at 200 volts direct current on a continuous basis. In addition, by using energy stored in large fly wheels, four times the continuous power may be made available at 160,000 amperes for two seconds. The short-time high-power operation will result in the production of extremely intense fields in a larger volume as compared to that available on a continuous basis.

Radiant Heat for High Ceilings

James R. Dodson, Jr., Pittsburgh mechanical engineer, designed a radiant heating system for the 77-ft high St. Sebastian Church, near Pittsburgh, Pennsylvania. The system is designed to operate at outdoor temperatures as low as 0 F. Water will be heated to 100-140 F by a boiler located in the basement at the sacristy end of the church. This water will circulate through a network of wrought iron pipe embedded in the main church floor. The floor is a concrete slab on grade. Heat will radiate to the surface where rays will be absorbed and converted to heat energy.

The output of the radiant system will be approximately 640,000 Btu, or 70 percent of required building heat. The additional 30 percent will originate from a supplementary forced air heating system.

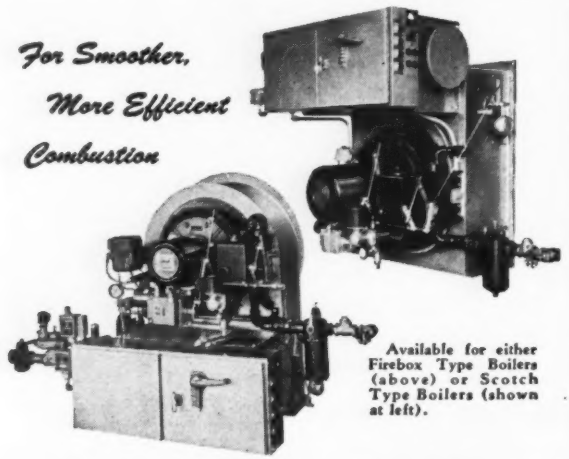


St. Sebastian Church will combine radiant and forced air heat to provide rapid response to demand changes.

The radiant slab output will be about 60 Btu per square foot. The combination of radiant heated slab and forced hot air enables the system to respond rapidly to changes in the number of occupants without override or lag. Wrought iron pipe was manufactured by A. M. Byers Company.

Sand Foundation for Parking Deck

William H. Weaver, Miami consultant, specified a foundation built on sand compacted by Vibroflotation for the five-acre parking deck between the entrance ramps of the Miami International Airport. The unusual foundation plan incorporates sand columns underground to a depth of 20 feet below the existing paved parking lot. The cylindrical compacted sand columns about 8 feet in diameter are overlapped according to a predetermined pattern for the footing areas. Each column compaction consumes a total of approximately three or four cubic yards of sand. ▲▲



Available for either Firebox Type Boilers (above) or Scotch Type Boilers (shown at left).

JOHNSON Forced Draft BURNERS

For firing with Oil only . . . Gas only . . . or Combination Oil or Gas. Wired, tested and completely assembled at the factory ready for easy, inexpensive attachment to any boiler or heat receiver. They provide smoother, more efficient combustion regardless of stack conditions and firebox pressure variations. Powered by the famous Johnson Mod. 53 Burners, these "packaged" units are available for any heating need, in sizes from 28HP to 560HP.

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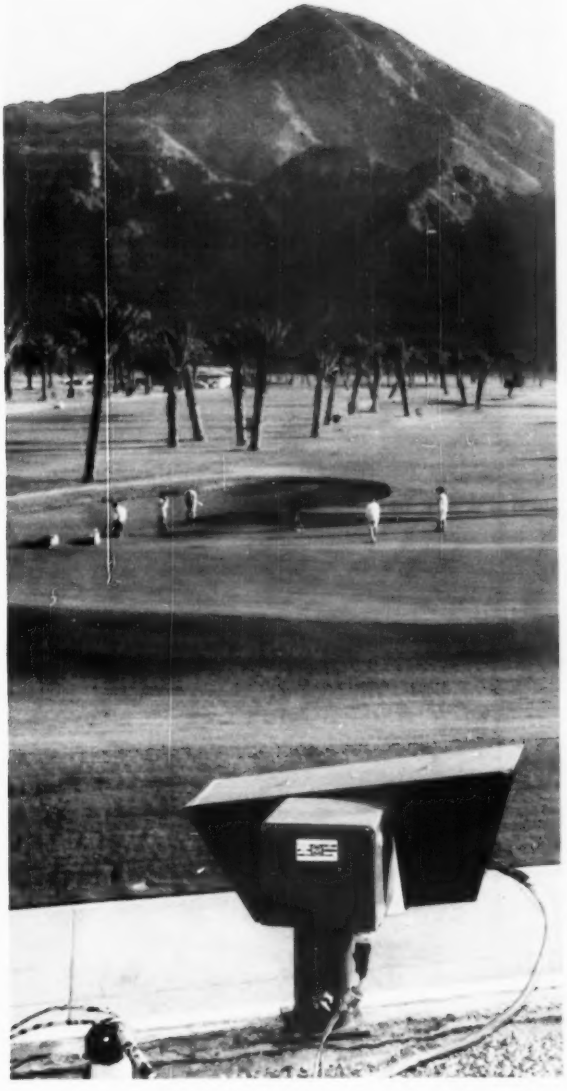
AUDIO NEWS
for consulting engineers

ELDORADO: FABULOUS SOUND SYSTEM FOR FABULOUS COUNTRY CLUB



RCA Sound System at Eldorado keeps members in touch from every location. System includes sound and closed circuit TV to provide unusually versatile communication services.

In a land where superlatives flourish as naturally as oranges, the new Eldorado Country Club of Palm Desert, California, must be classified as super-superlative. Everything about the club from the carefully manicured greens to the magnificently appointed locker rooms is the finest available. And thus when the decision was made to install a sound system, the Club's owners were determined to obtain facilities which would provide the optimum combination of functional flexibility and dependable performance.

"We wanted," said H. M. Eversz, construction operations supervisor of the Club, "the best sound system any facility of this type could obtain and there is no doubt in our minds that we made the right choice in selecting RCA and H&S Electronic Service Corporation to make the unique custom installation."

What H&S Electronic Service Corporation did install was actually three separate sound systems, which, taken as a unit, serve to give sound coverage to every area of the Club where members might conceivably need or want it.

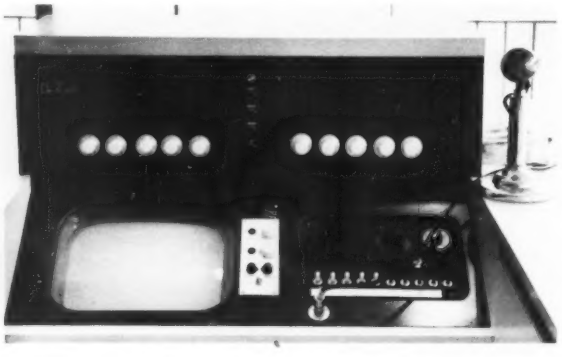
The first and largest of these systems distributes sound throughout the Clubhouse and to the 29 guest cottages. This is a four-channel system in which all the channels can operate simultaneously. Three of the channels have as their source AM-FM radio tuners, the fourth channel may be connected to a fourth tuner, a four-speed record changer, eight hour background tape or may pick up live programs through any of six microphone outlets. This system utilizes a total of 153 speakers, 75 of which are located in the Clubhouse, 74 in the cottages and an additional four in a social area. The main control panel for this system is located in the

Tuners, amplifiers and accessory rack equipment for main sound system are located in the phone room.

ELDORADO: THREE SEPARATE SYSTEMS FOR COMPLETE SOUND COVERAGE AND SERVICE

reception room of the Clubhouse. Guests in the cottages have selector switches which permit them to select any of the four channels.

The second system at Eldorado serves the golf course and related activities. Jimmy Hines, golf pro, and one of the directors of Eldorado, is particularly pleased with the facilities of this system which is controlled from a custom panel in the pro shop. "The starter can communicate with golfers and staff throughout the entire Club. He can call the caddy room, cart room, bag room, driving range and golfing area, four starting tees and the locker rooms. Within minutes after a member arrives in the parking lot, the sound system can order his car parked, his bag, his caddy, and his golf cart and have everything delivered at the first tee. This is a service we are proud of that does not exist anywhere else at this time," said Hines.



Control panel in Pro Shop from which starter can communicate with golfers and staff throughout entire club.

In addition to this unusual capability, this system also provides for two-way communication and paging. A TV monitor has also been installed in this panel. This monitor is connected to two closed-circuit TV cameras on the roof of the Clubhouse. These cameras give the starter a commanding view of the greens, and have been found to be invaluable during tournaments when rapid communication between various points on the course is necessary.

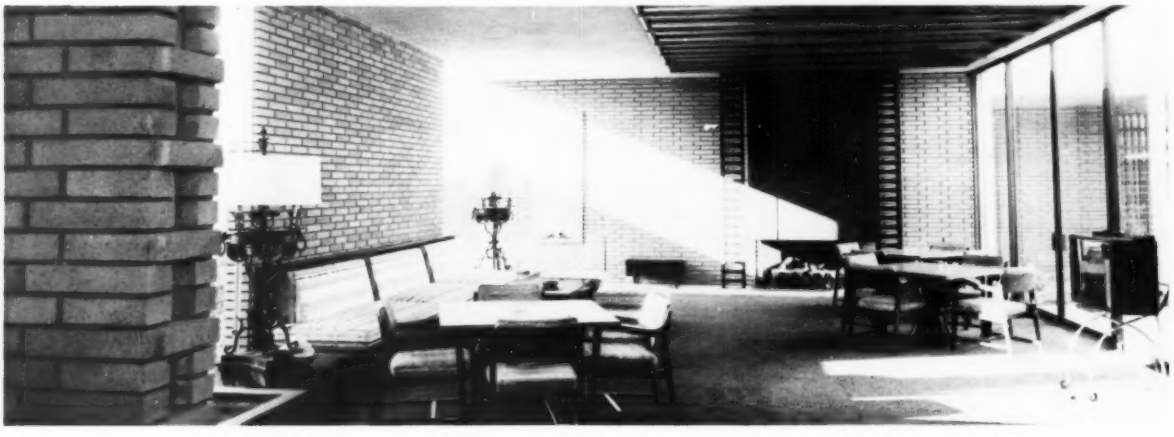
The third RCA sound system connects the Press Room, a closed room on the lower ground level, with the Men's Locker Room Bar. The function of this system is to aid the staff in giving members rapid and efficient table service. An annunciator system with buttons at each table instantly informs the staff when and where service is desired.

Commenting on the Eldorado sound system Mr. Eversz said, "It was essential that the sound system installed be the very finest. There were dozens of skeptics from neighboring clubs who doubted that we could succeed in getting the kind of sound system we wanted. We have proved that we have done exactly what we set out to do. The RCA equipment at Eldorado works perfectly; it is matched and balanced to provide exactly the service demanded of it."

In the country club set or outside it, whatever the application, satisfied clients are the rule with engineers who choose RCA Sound.

For technical information on the wide variety of intermatched sound components available, write: RCA Audio Products, Bldg. 15-1, Camden 2, N. J.

Concealed ceiling speakers provide sound coverage for lounge area at Eldorado.



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Men in Engineering

Fred S. Dubin Associates announce the appointment of Gene A. Gessner as associate in charge of the mechanical engineering department in the firm's New York City office. Gessner, formerly mechanical designer in Dubin's Hartford, Connecticut office, will handle all matters in the realm of heating, ventilating, air conditioning, and related areas of the mechanical engineering trades.

Harry Czyzewski, president of Metallurgical Engineers, Inc., Portland, Oregon, has been appointed by Governor Mark O. Hatfield to the Science, Engineering, and New Technologies Committee of the Department of Planning and Development. This committee has the important assignment of directing the scientific resources in manpower and facilities into channels that can make the maximum contribution to the economic development of the state of Oregon.

Los Angeles consulting engineers, Leeds, Hill and Jewett, Inc., has opened an office at 120 Montgomery Street, San Francisco, California. The appointment of two new vice presidents also has been announced — Walter G. Schulz, formerly chief engineer, Division of Design and Construction, California State Department of Water Resources, and Omar J. Lillevang, for merly supervising engineer, Leeds, Hill and Jewett.

John N. Rolston has been named business development representative for consulting and design engineering services by Commonwealth Associates, Inc., Jackson, Michigan. Rolston formerly was vice president in charge of the Chicago office of United Engineers and Constructors, Inc.

Harold H. Heidrick has been named public utilities consulting engineer for Wilsey, Ham & Blair, engineering and planning firm, of Millbrae, California. Heidrick, formerly with the California State Public Utilities Commission at San Francisco, will handle utility rate and valuation studies.

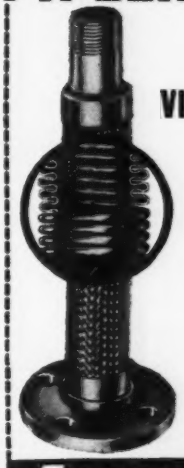
HEIDRICK

BUTLER

C. A. Butler has joined R. B. Mac Mullin Associates, consulting engineers, Niagara Falls, New York, as a partner, in charge of the Cleveland office of the firm. Butler formerly was director of engineering and director of commercial development for the Diamond Alkali Company in Cleveland.

Franklin T. Matthias has been appointed manager of heavy construction for Kaiser Engineers, responsible for all the firm's heavy

CALM Jittery PIPELINES



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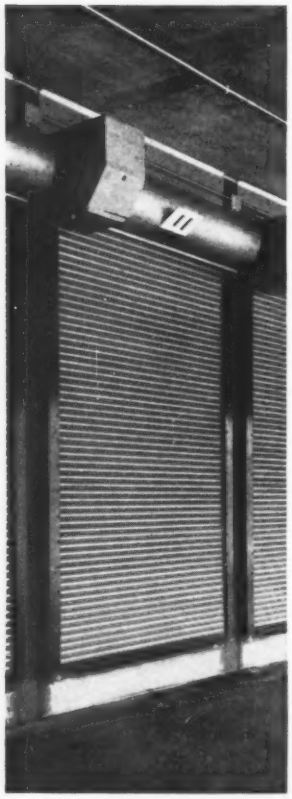
Kinnear Motor Operated **Rolling Doors...**

a feature of Theo. Hamm Brewing Company's

Automated Loading Dock



Here again, Kinnear Rolling Doors play a key role in *modern efficiency at its best!*

The 23 power-operated Kinnear Rolling Doors you see above are controlled independently from a master switch.

Conveyors ending just inside each door deliver pallets holding cases of beer to the loading dock. The door can then be opened by remote control. A fork truck picks up the pallets, travels onto dock levelers (at right, top photo) and loads the pallets on the waiting truck.

(Empty cases on pallets are returned to other conveyors through doorways installed higher above the dock level.)

By opening straight upward and coiling compactly over the doorway Kinnear Rolling Doors permit conveyors to come within *inches* of the door. Doors can be placed as close together as desired, with control switches at each door if preferred.

(Auxiliary chains, for door operation in case of power failure, are stored in the hood of each door.)

A rugged, all-metal curtain protects each opening when the Kinnear Rolling Door is closed — a positive barrier to trespassers, vandals, wind, and weather, *plus added protection against fire.*

Your needs may be vastly different; but *wherever you need* doors, you need the advantages of Kinnear Rolling Doors.

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Offices and Agents in All Principal Cities

KINNEAR
ROLLING DOORS
Saving Ways in Doorways

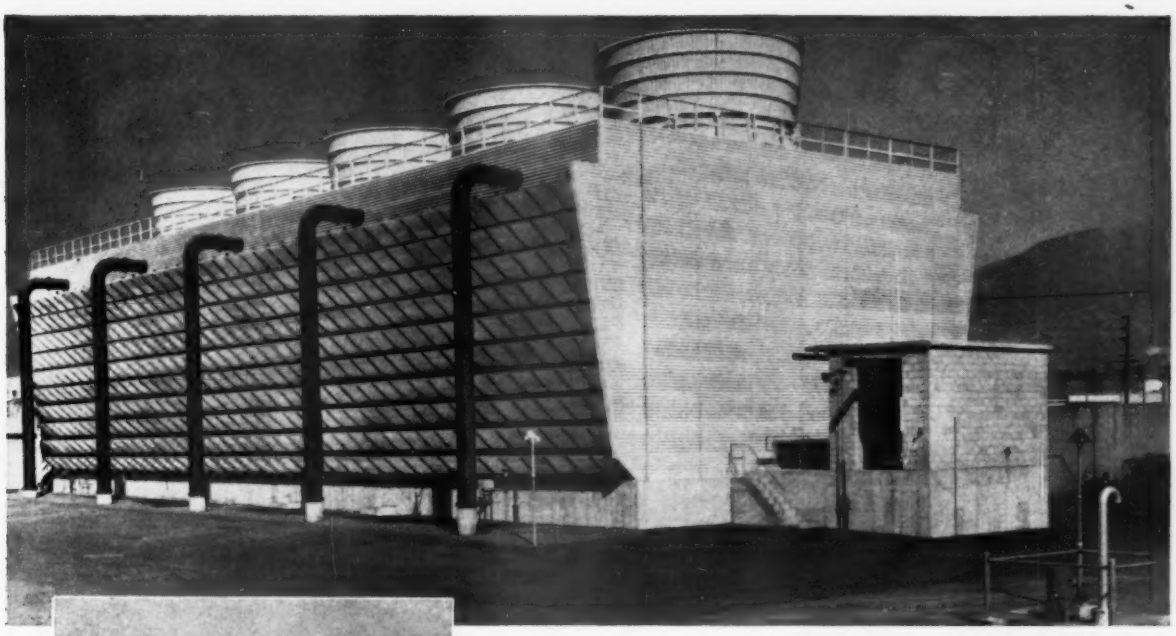
construction activities in the United States and Canada. Before joining Kaiser Engineers recently, Matthias was chief engineer and director of engineering and construction, Aluminum Company of Canada, Limited, and was responsible for the $150 million Chute-des-Passes hydroelectrical project in the Province of Quebec.

Elroy Baldner and Joseph Kinoshita, structural engineers, have disolved their partnership. Baldner has become associated with Stacy and Skinner, Los Angeles, representing them in their Houston, Texas office. Kinoshita is continuing in business under the firm name of J. Kinoshita and Associates.

Serge Kolesoff and John Kariotes, structural engineers, Pasadena, California, have dissolved their partnership. Kolesoff will continue in business at 259 S. Los Robles Avenue, Pasadena.

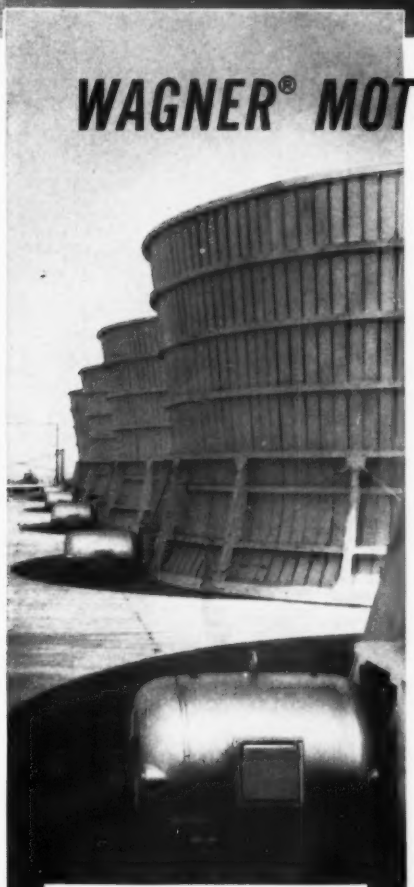
At their recent annual meeting held in Long Beach, the California Society of Professional Engineers elected the following officers and directors: president, Willard A. Holt, Arcadia; first vice president, Douglass R. Judd, Oakland; regional vice president, northern district, Bertram H. Hirsch, San Francisco; regional vice president, central district, Oliver Deatsch, Modesto; regional vice president, southern district, Robert F. Rocco, Garden Grove; treasurer, W. H. Dresser, El Monte; executive secretary, Leroy Martin, Hayward; national director, Fred M. Johnson, Modesto; alternate national director, Maurice Landau, Los Angeles; western regional vice president, John N. Stufflebeam, Tucson, Arizona.

George T. Treadwell, chief engineer for the Port of Seattle for the past 15 years, has joined the engineering and architectural firm of Tippetts-Abbett-McCarthy-Stratton as Pacific northwest manager, with headquarters in Seattle. As chief



WAGNER® MOTORS HELP MARLEY TOWER

PRODUCE *MORE POWER* FOR BURBANK



At work on the fan deck: Five Wagner Type EP, 75 hp, 480 volts, 1750 RPM Motors.

This is the new Marley Class 600 Double-Flow 5-cell cooling tower at the power station of the City of Burbank, California ... the newest thing in cooling tower design. Its job: to cool water to get more kilowatts from steam.

Wherever water cooling is vital to plant capacity, product quality or customer comfort, chances are you'll find a Marley Cooling Tower. You'll probably find Wagner® Motors there, too. They're on this tower in Burbank, driving the huge fans used in the tower's cells.

The job is a rugged one. It calls for motors that can operate without attention month after month ... motors that can stand constant exposure to all kinds of weather and to high humidity, the number one cause of motor failure in cooling tower applications.

Wagner Type EP Motors meet these requirements. All vital parts of these workhorse motors are totally enclosed, and are sealed against moisture by a series of grease retaining grooves between shaft and housing. Running shaft seals, at both ends of the frame, prevent the entrance of water into the bearing housings. The frames, endplates and conduit box are made of heavy cast iron for extra protection against high humidity and corrosion.

What about your requirements for motor drives that must operate under adverse conditions? Versatile Wagner Totally-Enclosed Motors can meet them, whatever the application. They are available in standard ratings through 500 hp. Call your nearby Wagner Sales Engineer for full details, or write for Bulletins MU-224 and MU-230.

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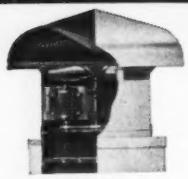
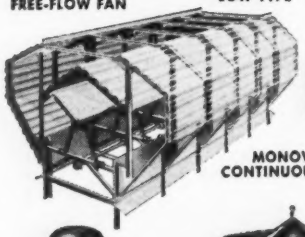
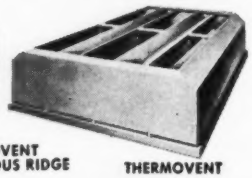

LOW TYPE

FREE EXHAUST FAN


MONOVENT CONTINUOUS RIDGE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MEMBER POWER FAN MANUFACTURERS ASSOCIATION

engineer for the Port, Treadwell supervised the design and construction of all Port construction projects including the Seattle-Tacoma International Airport, the 700-boat terminal for the commercial fishing fleet at Salmon Bay, and the 1600-boat Shilshole Bay Marina now under construction. In his new position, Treadwell will continue his work in the field of civil engineering, including waterfront, airport, and highway engineering.

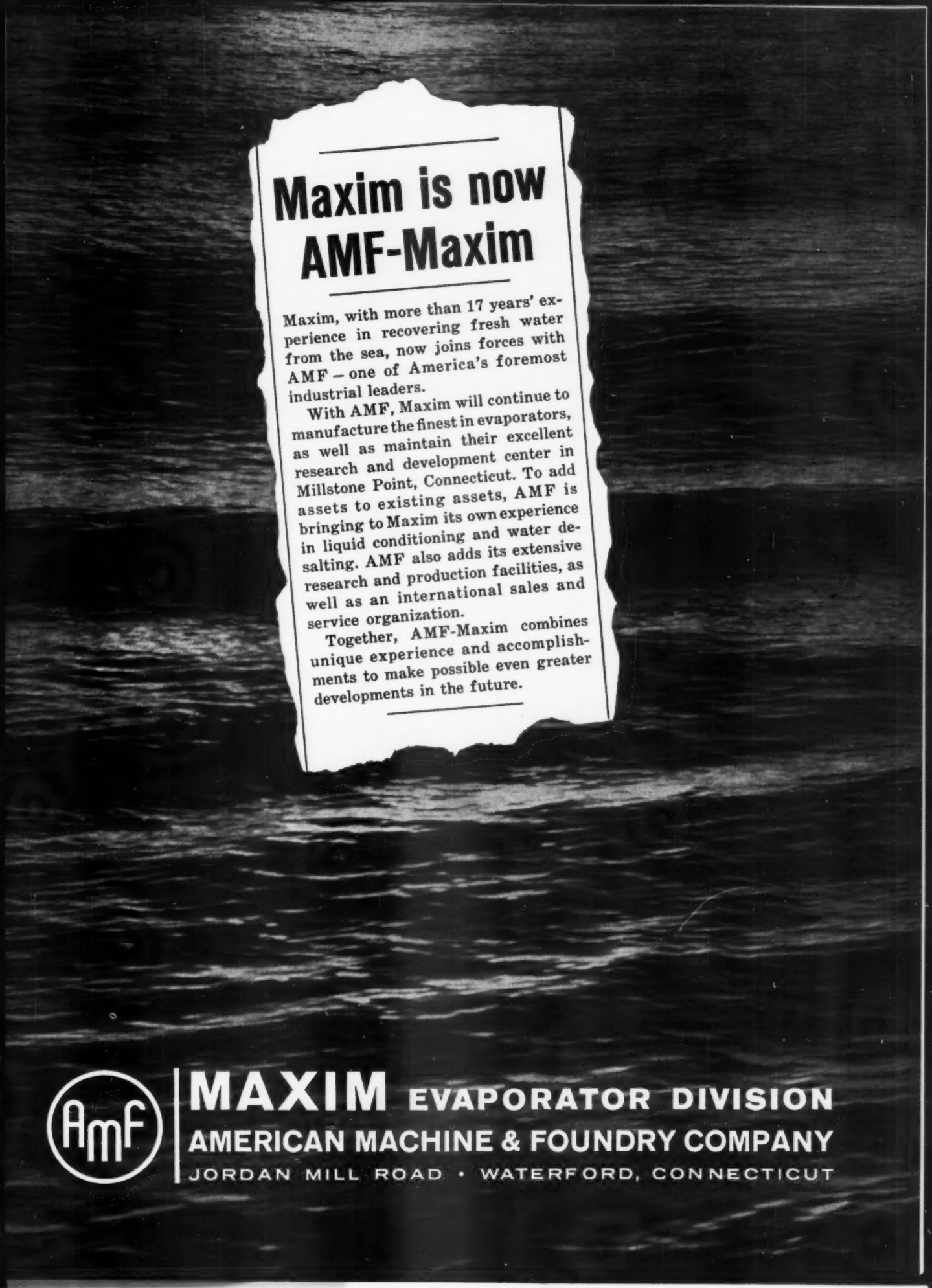
TREADWELL

CARLSON

William G. Carlson has been named director of defense and aeronautical projects by Burns and Roe, Inc. Since joining Burns and Roe in 1943, Carlson has directed engineering work concerned with Nike-Zeus anti-ICBM prototype installations in New Mexico; aircraft nuclear propulsion test facilities in Idaho; and a heat dissipation system for a new production reactor at the Atomic Energy Commission's Hanford operations area.

Two prominent members of Consulting Engineers Council have been named to important national committees by the U. S. Chamber of Commerce. Leonard K. Crawford, consulting civil engineer of Springfield, Illinois, will serve on the Transportation and Communications Committee and Ralph M. Westcott, Los Angeles consulting mechanical engineer, will serve on the Government Operations and Expenditures Committee.

Four engineers at the Birmingham, Alabama office of The Rust Engi-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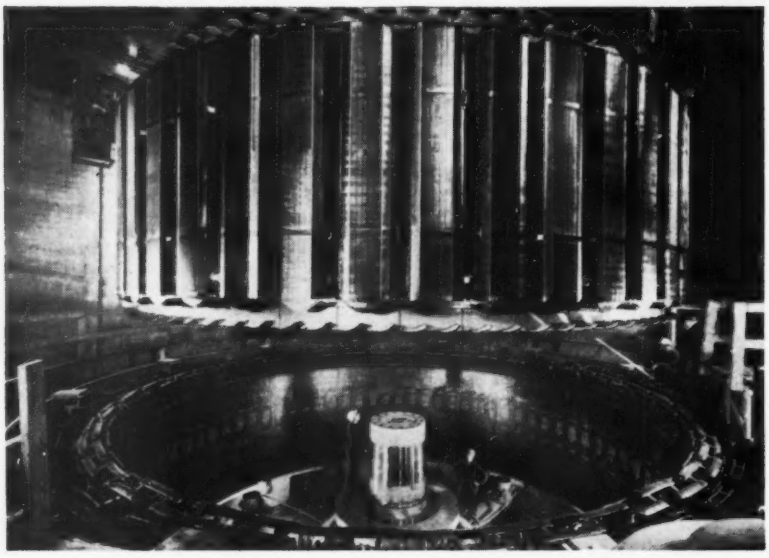

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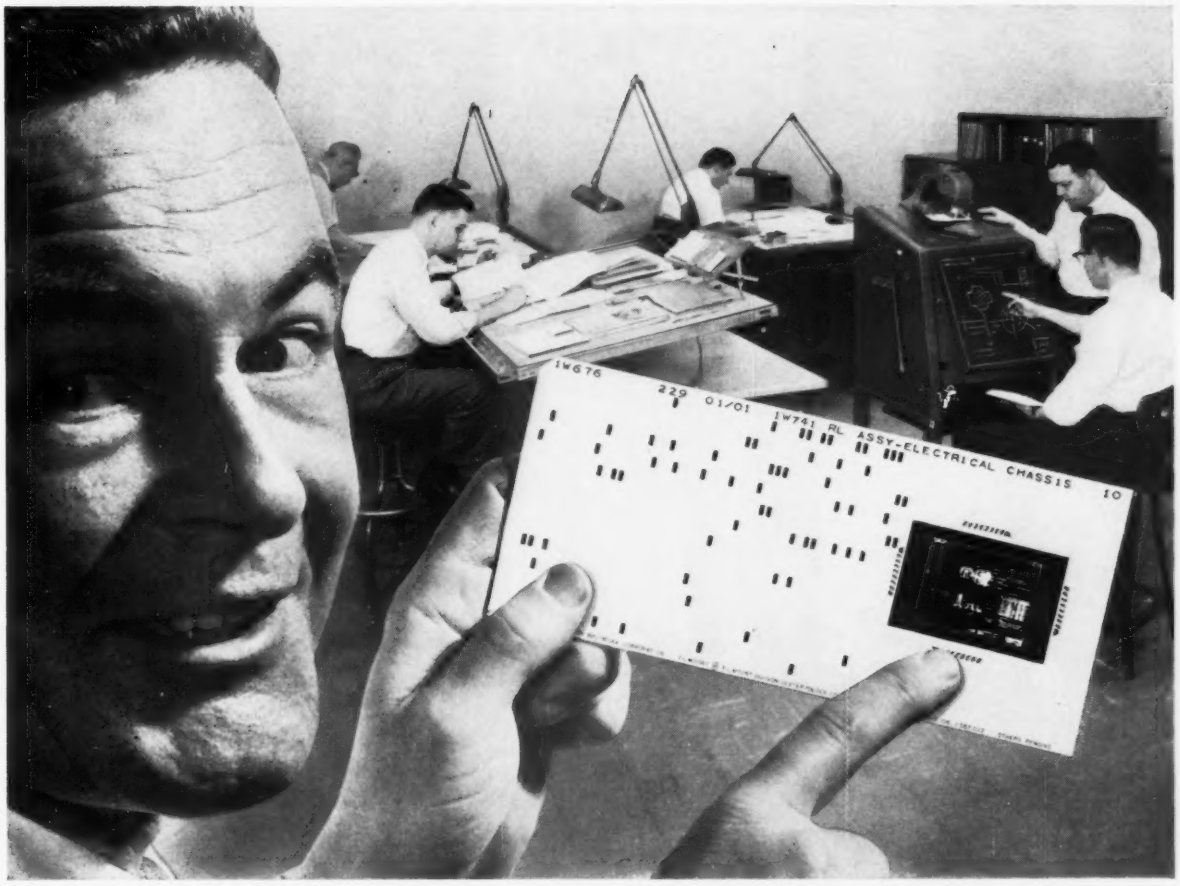
neering Company have been appointed to new positions. William F. Edmonds, formerly manager of sales, is the new chief engineer; A. H. Krause, formerly chief engineer, has been appointed project manager; Sam C. Hart, formerly a project engineer, has been appointed manager of sales; and M. G. De Shazo, Jr. has been appointed project manager.

Joseph S. Ward and Associates, Inc., consulting soils and foundation engineers, has opened offices and a soil testing laboratory in the Jefferson Building, 1015 Chestnut Street, Philadelphia, Pennsylvania. Alan Cohen, P. E. has been named vice president in charge of the new office. The firm undertakes site investigations, boring supervision, laboratory soil testing, foundation and pavement analysis and design, engineering consultation, and reports at both its new Philadelphia office and its Caldwell, New Jersey location.

Benham Engineering Company, Oklahoma City consulting engineering firm, has opened an office in Phoenix, Arizona, at 2727 N. Central, under the management of Chandler J. McCoy, executive vice president of the firm. McCoy formerly was director of public works for Grants, New Mexico, and is a former chief design engineer for Kermac Nuclear Fuels Corporation.

Stanley A. Frederickson has been named a principal in the firm of Baker & Moody, consulting engineers, Phoenix, Arizona. Frederickson, a registered professional engineer in Arizona and California, currently is vice president of the Arizona chapter of the American Society of Heating, Refrigeration and Air Conditioning Engineers.

John E. Stephens & Associates, engineers and architects of Phoenix, Arizona, has moved its office to Suite 308, Mayer Central Building, 3033 N. Central Avenue. ▲▲



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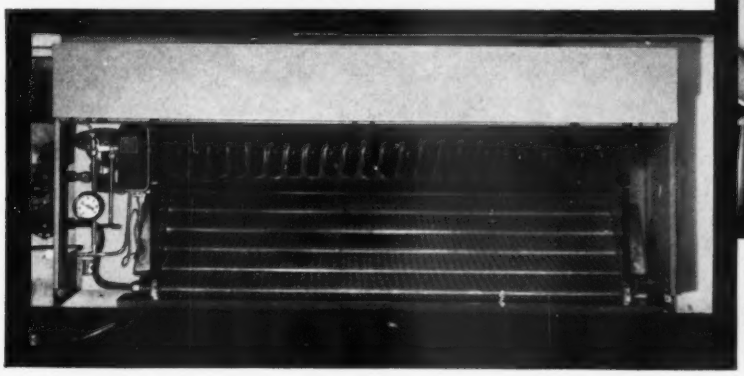
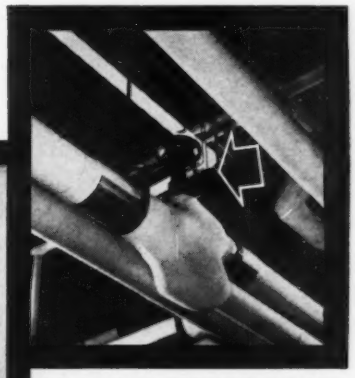
Over 2,000 Johnson thermostats maintain an ideal climate for business. Individual office controls eliminate a major cause of complaints, contribute to tenant satisfaction.

Johnson thermostats and water valves control over 3,100 induction units. These popular valves have an unmatched record of trouble-free service in such installations. The air gauge simplifies thermostat calibration, allows thermostat and valve operation to be checked at a glance.





Johnson 3-way mixing valves and by-pass valves can be serviced without removal, an exclusive Johnson feature that cuts service time over 50%. They also permit simple straightaway piping hookups for faster installation.

...assures ideal comfort, lowest lifetime costs

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As one of Chicago's top-rated buildings, the Kemper Insurance Building (formerly the Civic Opera Building) demanded air conditioning controls that would meet the very highest comfort standards. For economy, thrifty planners wisely also insisted on reliable, trouble-free controls.

A specially planned Johnson Pneumatic Control System meets both of these requirements. It provides coordinated operation of air conditioning systems supplying conditioned air at the rate of 600,000 cfm. The complex installation includes 8 large central fan air conditioning systems, 5 secondary water systems, and more than 3,100 underwindow induction units, all of which are Johnson-controlled. Offices throughout the 42-story modernized structure are individually regulated to maintain a comfortable, productive working climate for some 5,700 people.

Being pneumatically operated, the Johnson System functions dependably and with a minimum of supervision and upkeep. Both the system and its components incorporate economy features that result in important long-range savings.

Johnson Pneumatic Systems are designed and installed to provide the finest in modern comfort control at the lowest possible lifetime cost to your clients. A nearby Johnson engineer will welcome the opportunity to explain how these advantages can be applied to your next building or air conditioning project. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

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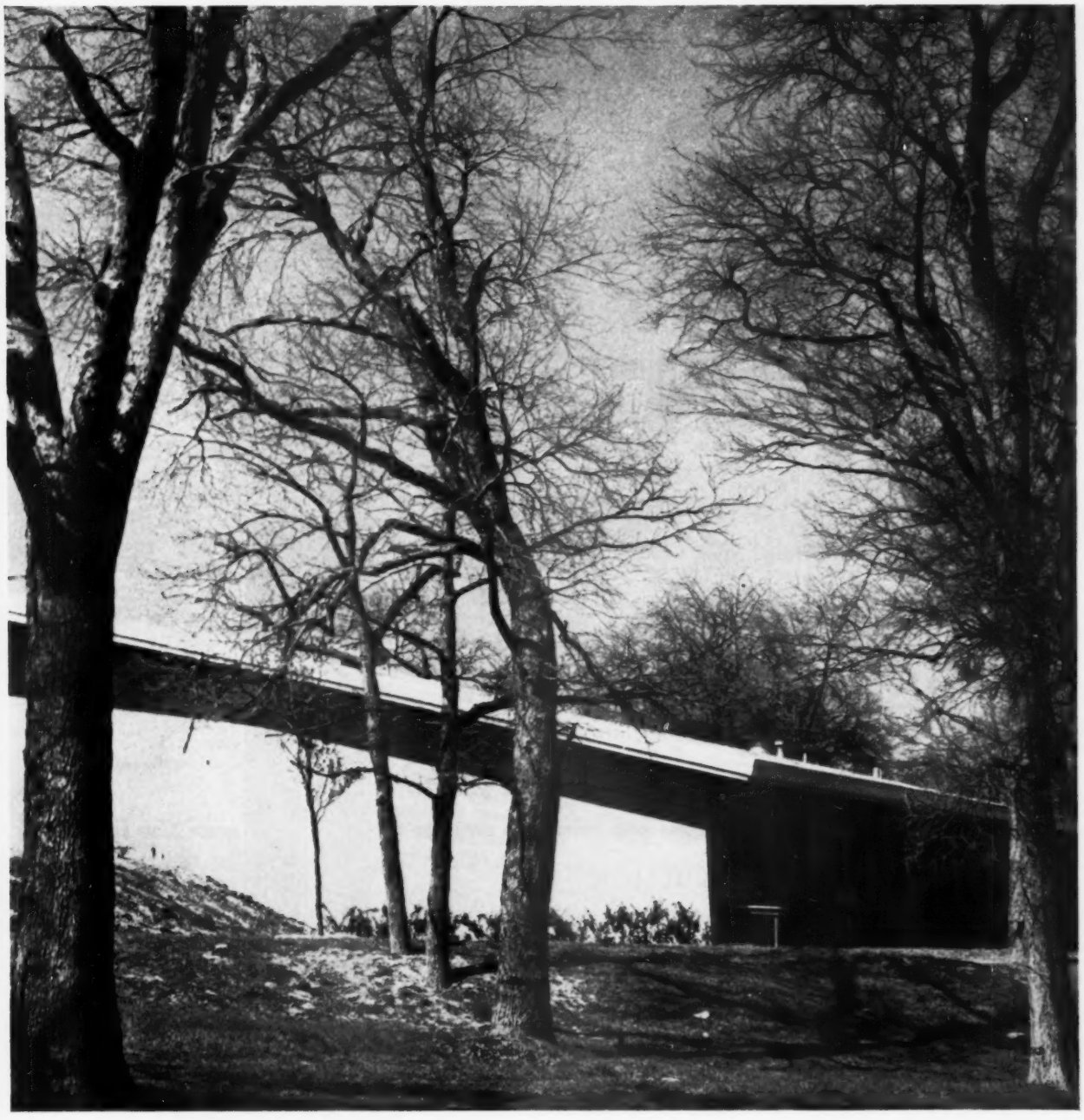
"We cool for pennies per hour with

"We wanted comfortable air conditioning for our recreation center. But we also wanted low operating costs," states Mr. Walter Hosek, Chairman of the Building Committee of Sokol Zizka—SPJST Lodge No. 130 in Dallas. "That's why we chose gas-operated Ready-Power Air Conditioning. Although the initial cost is slightly higher than some other available types, we figure that this unit will more than make up the difference in a few years."

Mr. Hosek is so right. Ready-Power Gas Air Conditioning units achieve the lowest known operating costs. *Less than one cent per ton per hour!* Cooling

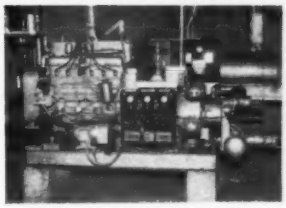


READY-POWER GAS Air Conditioning"

is constant, as opposed to the ON-OFF operation of other systems. *LOADMATCH CONTROLS* automatically adjust output and fuel consumption to actual cooling requirements. And thrifty gas keeps fuel costs low.

Get all the facts on the unusual economy and efficiency of Ready-Power Gas Air Conditioning. Call your local Gas Company, or write to the Ready-Power Company, Detroit 14, Mich.

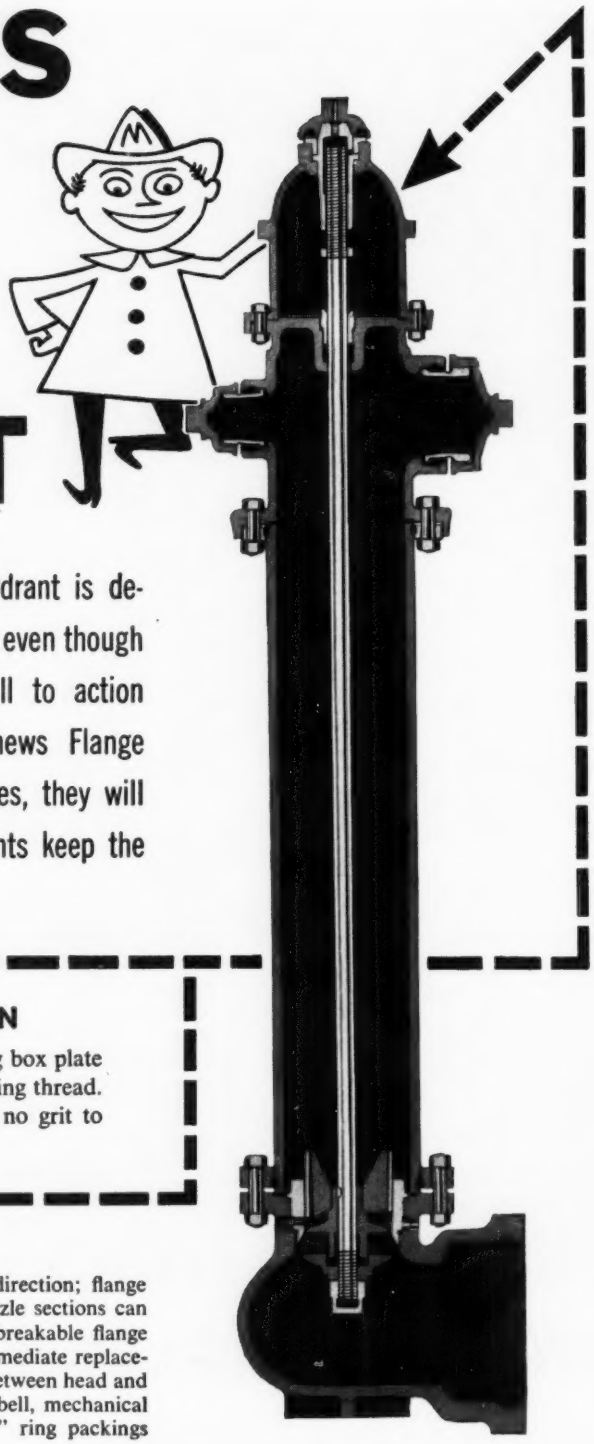
American Gas Association



This 60-ton, gas-operated Ready-Power unit gives Sokol Zizka in Dallas high efficiency air conditioning at lowest operating costs.

FOR AIR CONDITIONING GAS IS GOOD BUSINESS!

MATHEWS FLANGE BARREL HYDRANT



The most important single feature of any hydrant is dependability. It must be operable when needed, even though it has remained idle for years and the call to action comes during a hard freeze. Install Mathews Flange Barrel Hydrants, and when emergency strikes, they will be ready to serve! These outstanding hydrants keep the neighborhood safe.

DRY HEAD CONSTRUCTION

Cast integral with the nozzle section, the stuffing box plate keeps water and sediment away from the operating thread. No ice to jam the thread in freezing weather; no grit to wear out the operating thread.

AND THESE FEATURES, TOO:

A swivel flange permits nozzles to be faced in any direction; flange barrel reduces accident costs because top cap and nozzle sections can usually be salvaged from broken hydrant • Optional breakable flange and stem coupling snaps in traffic accident, permits immediate replacement without excavating • Extension piece insertable between head and barrel or between barrel and elbow • Available with bell, mechanical joint or flange pipe connections; conventional or "O" ring packings

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Parallel Reading for Consulting Engineers

Ingenious Mathematical Problems and Methods, by L. A. Graham; Dover Publications, Inc., New York, N. Y.; $1.45.

Designed for puzzle addicts, this little book is the latest in a number of similar pocket books published by Dover for the amusement of those who cannot resist testing their mathematical prowess. This particular group of problems was selected from a column in the house organ of Graham Transmissions, Inc., of Menomonee Falls, Wisconsin. For over 17 years this column has printed scores of mathematical problems, many of them created especially for the little magazine by its more than 25,000 readers. Since most of these problems were designed by engineers and mathematicians, consulting engineers will find them both fascinating and challenging.

•

Conflict of Interest & Federal Service, by the Association of the Bar of the City of New York, Special Committee on the Federal Conflict of Interest Laws; distributed by the Harvard University Press, Cambridge, Mass.; $5.50.

About five years ago, the Bar Association in New York City began a study of the highly confused Federal conflict of interest laws, with the idea of rewriting the statutes to fit the times. Since consulting engineers working on government projects are under the jurisdiction of these laws, the report and legislation pending as a result is a recommended addition to the consultants' library. As the authors, who were obviously preoccupied with scientists rather than engineers, explained it:

"For the scientist asked to serve the government as a consultant, the provisions of Section 281 and of Section 1914 could be extremely troublesome. The former, forbidding the government employee to provide compensated services to another 'in relation . . . to any . . . matter' in an executive form can, in view of the absence of limits to this broad language, make almost any consulting work dangerous . . . Indications are that as yet there is little general awareness in the scientific community of these statutes, though some company counsel have become conscious of the problem. Section 1914, fundamentally unworkable in the case of intermittent employees, appears to be unknown to and ignored in practice by the consultant, though not by the full-time appointee.

"It is not the purpose of this chapter to point with alarm. No indication has been seen of improper conduct on the part of any scientific advisers; every evidence is of dedicated professional men continuously giving of themselves to their profession and to the government."

One consulting engineer, who has tangled with the complicated conflict of interest laws, is included in case histories of persons who have learned about the Federal rules the hard way:

"The Antitrust Subcommittee of the House Judiciary Committee in 1955 investigated the activities of

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THIS (they tell us) means "crisis," in Chinese. One character spells "danger". The other, "opportunity".

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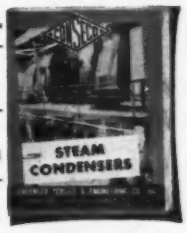

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PLANKINTON HOUSE

Peter A. Strobel, Public Buildings Commissioner. Strobel had been a partner (and again is) in a firm of consulting engineers, and under a modified arrangement, he retained his partnership interest on entering government service. In a highly partisan hearing, it was charged that as a government official he had continued his activity in the partnership and had solicited business for it. Three Democrats on the subcommittee concluded that Strobel's position was 'fundamentally inconsistent and untenable.' The three Republicans on the subcommittee found no evidence of 'any conduct that was unethical or in violation of any conflict of interest statutes,' though they agreed that Strobel's retention of a substantial interest in his firm placed him in a 'fundamentally inconsistent and untenable position.' A fourth Democrat, who was resigning from the House, filed a letter with the subcommittee between the time of the hearings and the time the subcommittee met to consider them. He found any implication of wrongdoing by Strobel 'completely unjustified.' In the meantime, before the subcommittee report was out, Strobel had resigned."

The book has two themes. Ethical standards in the Federal government must be beyond reproach. Yet at the same time, the laws should be realistic enough not to discourage honest and qualified people from government work – either on a full-time or consulting basis. Conflict of interest is considered a luxury issue, which comes to light only when people do not have more pressing problems to worry about.

Conflict of interest is nothing new, but worrying about it dates back to pre-Civil War days. For instance, in 1833, Senator Daniel Webster wrote the president of a bank that President Jackson was proposing a withdrawal of United States deposits from the bank. Webster asked if the bank president needed any help, adding that:

"Since I have arrived here, I have had an application to be concerned, professionally, against the Bank, which I have declined, of course, although I believe my retainer has not been renewed, or refreshed as usual. If it be wished that my relation to the Bank should be continued, it may be well to send me the usual retainer."

During the Civil War period, Congressmen were advertising their availability in Washington papers.

Currently, there are seven statutes dealing with conflict of interest. In addition, many agencies have their own regulations.

In the Export-Import Bank, employees may not recommend the services of any attorney, engineer, economist, or other consultant to anyone who is or might in the future be dealing with the Bank. The General Services Administration forbids its employees to accept gifts or favors from anyone currently dealing with GSA, or who might in the future get a GSA project. The Atomic Energy Commission has a similar regulation.

In addition, "The Atomic Energy Commission brings to the attention of its many consultants at the time of their appointment the Commission's rules of conduct, including those dealing with conflict of interest. In employing consultants, the AEC uses a Personal Service Contract in which the consultant states that he is 'familiar with and agrees to conform to the provisions of the Commission policy regarding conflict of interests'; insofar as he knows, 'there does not exist any actual or potential conflict between his private interests (including corporate stockholdings) and his services for the Commission'; and he 'will, in the event of a change in either his private interests or services for the Commission, raise with the Commission any question regarding possible conflict of interests which may arise as a result of such change.'"

Government employees who use their positions to line up post-re-

EVERY 3-YEAR-OLD KNOWS...

what some transformer manufacturers have forgotten

Before he could talk, Junior learned that *resiliency absorbs shock*—that a marble dropped on the floor makes more noise than one dropped on a pillow. Elementary? You'd be surprised how many transformer manufacturers forget this simple fact when they design a cabinet model. Or maybe you wouldn't be surprised—maybe you've heard some of them roaring away.

On every JEFFERSON dry type cabinet transformer the core and coil are *completely isolated* from the cabinet—floating on a resilient cushion of rubber—minimizing vibration and sound. JEFFERSON gives you the quiet operation that is always desirable, and necessary in hospitals, libraries, offices and schools.

They're designed to last longer, too. JEFFERSON engineers have provided plenty of wiring space by mounting core and coil *above* the base so that wiring is never exposed to higher than ambient temperatures. JEFFERSON insistence on quality is reflected by the fact that every cabinet must have three coats of paint—every bolt must be plated—a reassuring fact when your transformer must perform under humid conditions.

These are just a few examples of the expert engineering that has made JEFFERSON transformers the preferred line.

Cabinet Models available in:

Single Phase—
25KVA through
100KVA

Three Phase—
112.5KVA
through
300KVA

Jefferson *DRY TYPE* TRANSFORMERS

Jefferson Electric Company • Bellwood, Illinois

WHATEVER YOUR REQUIREMENTS FOR ROTARY PUMPS, THERE'S A ROPER TO DO THE JOB

Series T .3 to 55 GPM
Choice of 192 Models

Pump and motor units . . . pump serves as end bell of motor. Require minimum space . . . easily installed . . . no coupling required . . . mount in any position. Each unit approximately same size as NEMA motor of HP required for driving. Open drip proof or totally enclosed motors; single or three phase as required.

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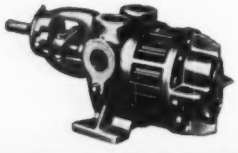
ROTARY PUMPS



ROPER
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Series F 1 to 300 GPM
Pressures to 300 PSI

Feature helical steel pumping gears, hardened steel shafts, bronze flange-type bearings. 4-port design with 8 optional piping arrangements (4 for CW and 4 for CCW rotation) solves installation problems. With or without built-in relief valve in either mechanical seal or packed box construction.

Series K ¾ to 50 GPM
Pressures to 150 PSI

Extremely compact in all sizes. Helical pumping gears are hardened steel, with steel shafts and bronze bearings. Sizes 10 through 50 GPM have patented venturi suction and discharge principle for smooth flow and quiet operation. With or without built-in relief valve; packed box or mechanical seal.

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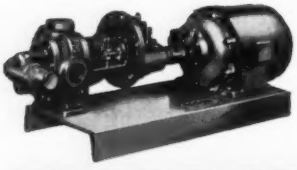
Series H 5 to 75 GPM
Pressures to 1000 PSI

Designed to operate at direct motor speeds. Used for all types of hydraulic mechanisms where high pressures are required. Hardened steel spur gears for maximum efficiency, and heavy duty roller bearings and bronze wear plates for long life service. Mechanical seal or packed box.

Series 3600 40 to 300 GPM
Pressures to 100 PSI

Handle thick or thin liquids at slow speeds. Operate in either direction. Hardened iron pumping gears, hardened steel shafts, heavy duty bronze sleeve bearings. Mechanical seal or packed box. Series includes tank truck pumps as well as single motor driven units with gear reduction.



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"How to Solve Pumping Problems"

Roper Hydraulics, Inc. COMMERCE, GEORGIA
Manufacturers of Standard, Special and Custom Pumps for All Industries

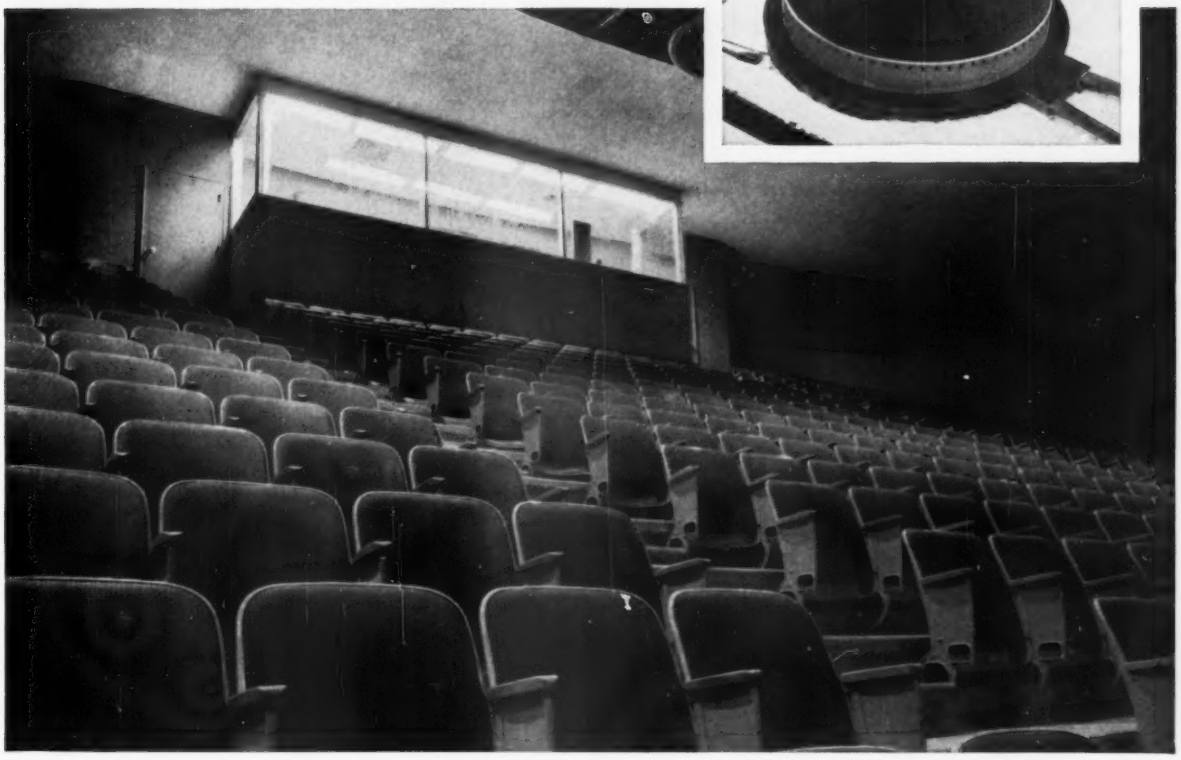
tirement jobs also get their share of attention in the book. "Interviews revealed a substantial body of opinion that government employees who anticipate leaving their agency someday are put under an inevitable pressure to impress favorably private concerns with which they officially deal. Conceivably, an offer of a later job might be used as the pay-off for favors done while in office, but this is rank bribery, subject to criminal prosecution, and not the point here. The risk is not bribery through the device of job offers; the risk is that of sapping governmental policy, especially regulatory policy, through the nagging and persistent conflicting interests of the government official who has his eye cocked toward subsequent private employment. To turn the matter around, the greatest public risks arising from post-employment conduct may well occur during the period of government employment, through the dampening of aggressive administration of government policies."

The committee of authors proposes a single bill to replace the current seven – most of which are outdated through too much attention to "claims against the government."

In the proposed law, a new enforcement weapon is provided. The United States could collect damages in an amount equal to three times the amount of any economic advantage to an employee. The degree of purposeful intent required to be shown in order to bring such civil suits would be less than the degree of intent necessary for criminal penalties.

The authors point out the importance of covering consultants in any new laws. "In 1959, the United States government spent nearly $5 billion on research, engineering, and development, including procurement funds for research and development. This was more than the government spent for that purpose in the four decades between

Stereo sound reproduction and reinforcement, private internal telephone communications plus a complete paging network are combined in a single system at the new Utica Memorial Auditorium, Utica, New York. Architects: Gehran & Seltzer of New York City. Associate Architect: Frank C. Delle Cese of Utica. Consulting Engineers: New York City office of Fred S. Dubin Associates. Installation by W. G. Brown Sound Equipment Corp., Syracuse, N. Y.



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- Provides choice between selective area or overall paging network.

Stromberg-Carlson is the *only* audio manufacturer who can offer a complete, versatile line of components—from telephone and loudspeaker intercom system to stereo high-fidelity auditorium equipment.

For detailed information on how you can offer your clients significant savings in design time, installation and cost with Stromberg-Carlson "Custom Engineered" Communications Systems, call your local Stromberg-Carlson Communications Consultant. For his name, call Western Union Operator 25, or write:

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Thompson Hangers reduce servicing costs and eliminate all climbing and electrical dangers automatically. They permit one unskilled man . . . without assistance or special auxiliary equipment or personal hazard . . . to service a fixture within a few minutes at floor level. And that's why Thompson Hangers are the fastest, safest and most economical method of maintaining peak lighting efficiency at minimum cost.

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1900 and 1939 – and more than the total Federal budget a generation ago. Today about one-half of all scientific research, engineering, and development carried out in the United States is paid for by Federal money. For 1960 about $5.5 billion has been budgeted for scientific research and development programs.

"The government's increasing use of consultants and experts has periodically been debated and investigated. Opponents fear that the practice exposes the government to infiltration by private interests liable to use the power of government to their own advantage. But though there are risks in not limiting the conduct of government to regular officials, the continued rise in the number of consultants and other part-time workers indicated that these people are filling a basic need, that they are the only available source of the expertise and special experience the government requires constantly today. As governmental functions and private functions overlap, government must be assured of a regular flow of information from the private sector of the economy, and vice versa.

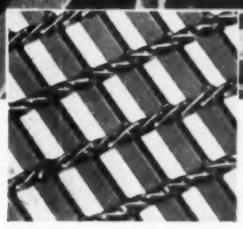
"Any amendment to the present structure of conflict restraints must be adapted to this new major factor in the personnel system of American government. . . . A well administered program could, and should, guide the thousand good men as well as snare the one bad man."

•

New Technical Books

RADIATION PYROMETRY AND ITS UNDERLYING PRINCIPLES OF RADIANT HEAT TRANSFER, by Thomas R. Harrison; John Wiley & Sons, Inc., New York, N. Y.; $12.00. Material in the first three chapters offers a unified discussion of the laws of emission, absorption, reflection, and transmission of thermal radiation, applicable to the field of radiant heat transfer as well as radiation pyrometry. The remaining chapters

EXTRA SAFETY UNDERFOOT in this New Glass Plant . . . with KERRIGAN *Weldforged* Grating & Treads!



TWISTED Cross Bars ALTERNATE right & left for an EXTRA margin of Walking Safety

When you specify Kerrigan Weldforged grating you get the utmost in underfoot and underwheel safety . . . in addition to its well known economy features. Bearing bars, and cross bars that alternate right and left, are electronically weld-forged into inseparable, one-piece units that stand up under the severest kind of punishment.

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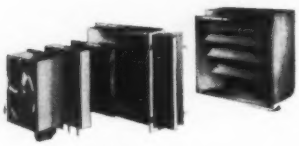
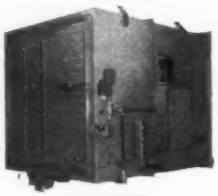
Your best investment in modern air-handling equipment! New Aerovent Air Make-Up Units provide clean, fresh air in winter or summer; help maintain uniform temperature levels throughout working areas. Used as filtered-air supply units or air preheaters, these versatile units permit heating and ventilating systems to operate at design efficiency; equalize negative pressures by replacing exhaust air.

Steam, hot water or gas-fired models in sizes 18" to 54" (larger units available on order) for capacities, pressure conditions and BTU ratings to suit your requirements. Compact, packaged design for roof or wall mounting. Other assemblies also supplied for exclusive use in air supply or air heater applications. Why not investigate the many advantages of these high-efficiency units, today?



STEAM OR HOT WATER

Furnished in 7 unit arrangements in sizes 24" to 54". Capacities from 5,000 to 35,000 CFM. Roof or wall types for all requirements.



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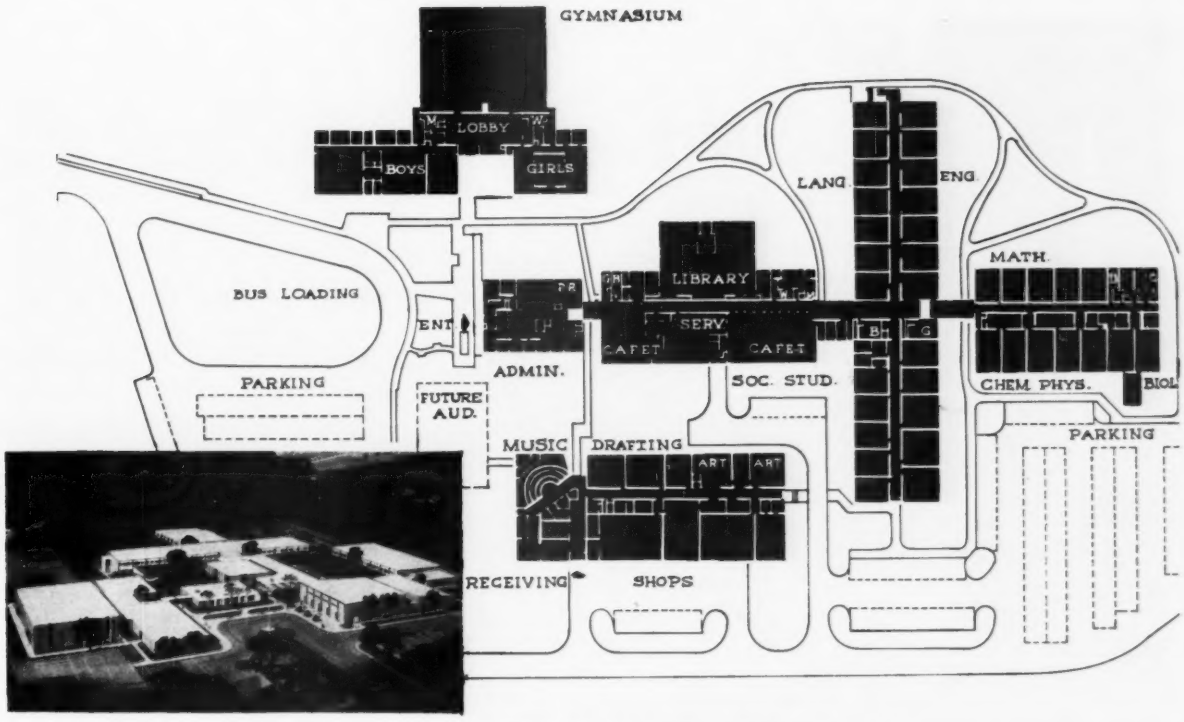
include important descriptions and mathematical analyses of the physical and operating characteristics of radiation pyrometers and the application of emittance corrections. The last chapter lists a number of valuable tables that show radiation pyrometer calibrations, optical characteristics of various substances, some radiation functions, and mathematical relationships used in radiation pyrometry.

DIGITAL COUNTERS AND COMPUTERS, by E. Bukstein; Rinehart & Co., Inc., New York, N. Y.; $7.00. This book approaches the subject of computer technology in two distinct yet allied ways. The first is from the point of view of electronic circuitry, including a clear explanation of such basic components as "flip-flop" circuits, logic circuits, and switching circuits. It then discusses the number theories and counting systems by means of which the computing machinery performs its calculations. It also deals with the "readout" devices which translate the computers results into usable form. A special section deals with the important topic of digital-to-analog and analog-to-digital conversion.

CATALYSIS, Vol. 7, edited by Paul H. Emmett; Reinhold Publishing Corp., New York, N. Y.; $13.50. This book is the last in a series providing research chemists with the most soundly conceived reference source ever published on physical chemistry or catalysis and catalytic processing. It includes four chapters on catalytic oxidation, one on hydration-dehydration, and one on cracking catalysts.

FLUIDIZATION AND FLUID-PARTICLE SYSTEMS, by Frederick A. Zenz and Donald F. Othmer; Reinhold Publishing Corp., New York, N. Y.; $15.00. The result of over 17 years of research and study, this book provides a convenient, centralized information source on all major aspects of fluid-particle technology,



PLANNING THE NEW SCHOOL

This unusual new high school in Darien, Conn. has a present enrollment of 810 pupils, yet can easily be expanded to accommodate the 1200 to 1300 student population expected within five years. Architects Ketchum & Sharp, consulting engineers Cosentini Associates, and a hard working school building committee planned wisely for both present and future while keeping square foot costs below those of Darien schools built in 1948 and 1951.

General Contractor – Deering Construction Company

Electrical Contractor – Wilton Electric, Inc.

AT DARIEN . . . the need for an efficient Electronic Time Control and Program system, free of operation and maintenance problems lead to the selection of Stromberg. Dependably correct clocks and signals are assured by the precision Master Time Control which automatically supervises secondary units hourly, as well as at 12 hour intervals – *and* program signals are immediately corrected following a power failure. These synchronizing signals operate on ordinary lighting circuits – require no special wiring; all correction cycles are completed in only 60 seconds. Stromberg's exclusive seven-channel transmitter may be arranged with one frequency for clock supervision and the other six for program signals; this program unit will handle as many as 1440 signals daily on each circuit and is fully modular in that channels can be added as needed without new wiring costs.

Scope (Stromberg Central Operations Panel Electric), in any standard Stromberg installation, will control all clocks and audible signals, as well as automatically program the "on-off" of lighting centers, heating and air conditioning and ventilating for optimum cost efficiency *And* – SCOPE manual controls permit temporary changes at any time without interference with the basic schedule.

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locates pipeline holidays and electrical contacts underground

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This completely transistorized unit finds trouble spots underground without the necessity of uncovering the pipe. Working in tandem, a two man crew can inspect an entire line, locating coating breaks, contacts with other lines and mapping the entire line.

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dealing with the significance and methods of measurement of the angles of repose, internal friction, rupture, wall friction, and slide. It reviews the details of particle shape factors and their applications in calculating pressure drop in fluid flow through particle beds. It also presents a generalized correlation for calculating the rate of entrainment of solids from fluidized beds for any particle size and distribution, superficial fluid velocity, and height above the bed.

MONORAILS, by Hermann S. D. Botzow, Jr.; Simmons-Boardman Publishing Corp., New York, N. Y.; $3.95. This book gives an objective view of the potential of monorail transportation in the United States. Facts and figures are cited. After a historical introduction, the author discusses types of monorail cars, tracks and structures, stations, wayside equipment, particular monorail characteristics, and the economics of monorail as a means of transportation. Of considerable interest are the appendices of the book, one of which describes every known operative monorail, plus tables of technical data on car characteristics, rail supports, rail cross sections, and necessary platform clearances.

FLUID POWER CONTROL, edited by John F. Blackburn, Gerhard Reethof, and J. Lowen Shearer; The Technology Press and John Wiley & Sons, Inc., New York, N. Y.; $17.50. This book is a direct result of the research and development efforts of the staff and students in the Dynamic Analysis and Control Laboratory of Massachusetts Institute of Technology. It consists of four major parts, beginning with a review of fluid properties and fluid mechanics. The second section deals in considerable depth with the theory and practice of hydraulic control components. The last two parts describe recent progress in the use of gaseous working fluids, especial-

How about treating your family to a better chance against cancer?

You give your family the best of everything . . . all-day outings in the car, maybe a movie after, and then a soda to top it all off. There's really nothing you wouldn't do to make your family happy.

And if you could help make them safe . . . safe against cancer, you'd do that too, wouldn't you? And fast. Well, you *can* help. The American Cancer Society needs your dollars right now. It needs them for research, which is making important gains against the killer. For education, which gives everyone life-saving facts about cancer. For service, which aids and comforts the stricken.

Don't skip the treats that make life pleasant for the family. But don't skip the chance to strike back at a disease that threatens them. Match the cost of that next outing with a check to the American Cancer Society. That's the most worth-while treat you could give! Send your check to "Cancer" in care of your local Post Office today.

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HEINEMANN HAS A CURE FOR THE NUISANCE TRIPPING AILMENT

THE SYMPTOMS of panelboard sickness are easily recognizable. Breakers trip mysteriously. Service is interrupted without apparent reason. Yet there is no evidence of circuit faults.

THE CAUSE of the malady is, usually, ambient heat acting upon thermal-type protectice devices. Such devices are designed to respond to the heat produced by load current. Trouble is, ambient heat gets added in with current-produced heat. Result: "artificial" overloading of the circuit . . . nuisance tripping.

THE CURE is obvious. Change over to circuit protectors that are not heat sensitive. Heinemann circuit breakers, for example. Heinemann breakers are magnetically actuated, have hydraulic time delay to allow for starting inrush or harmless transient overloads. They operate directly on load current, not the heat generated by that current. So: there's no heat effect on current-carrying capacity. No nuisance tripping. Just safe continuity of service . . . always.

FOR MORE INFORMATION, SEND FOR BULLETIN 3103

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ly high-pressure pneumatics, with concepts of system analysis and design, and with actual system designs based on earlier chapters of the book.

THERMODYNAMICS, by Herbert B. Callen; John Wiley & Sons, Inc., New York, N. Y.; $8.75. Proceeding deductively from a few basic postulates (which are made plausible by a short qualitative discussion of their statistical mechanical bases), the author develops a self-contained, simple, logical theory of thermodynamics, and shows that the entire subject with its many applications is, in principle, a direct consequence of these postulates. This approach reveals the essential simplicity of the subject and leads to a more profound understanding of it. Topics of modern interest covered are stability, second-order phase transitions, and fluctuations.

MECHANICAL PROPERTIES OF INTERMETALLIC COMPOUNDS, edited by J. H. Westbrook; John Wiley & Sons, Inc., New York, N. Y.; $9.50. This book, based on a symposium held in Philadelphia in May 1959, sponsored by the Electrothermics and Metallurgy Division of the Electrochemical Society, Inc., is a volume in the Wiley Electrochemical Society Series. The book covers phenomenology of the mechanical behavior of intermetallics, theoretical and experimental investigations of particular properties, experimental techniques for the preparation and study of intermetallics, and an extensive review of the literature. This book is the first and only explicit treatment of the mechanical properties of intermetallic compounds.

SURFACE EFFECTS ON SPACECRAFT MATERIALS, edited by Francis J. Clauss; John Wiley & Sons, Inc., New York, N. Y.; $11.50. The book begins with a study of the temperature control problem. Among the subjects reviewed are the meth-

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Automatic valveless gravity filter: Costs up to 45% less than conventional filters. Also saves money after installation, because it operates automatically without a single valve, agitator, pump, flow controller, or even an attendant operator. **Bulletin 4351.**

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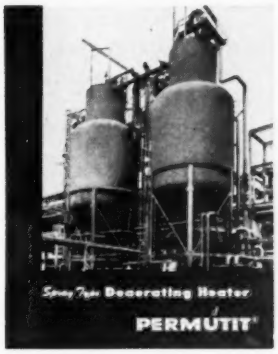
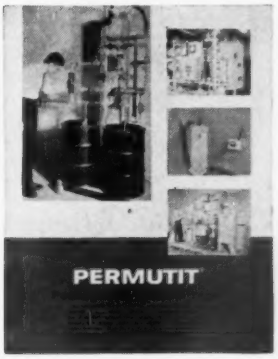


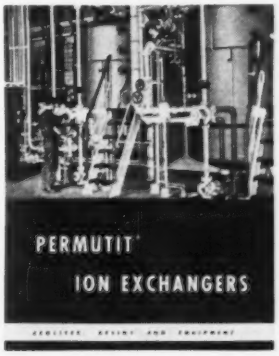
Deaerating Heaters: Designed for removal of carbon dioxide and oxygen from boiler feedwater. Permutit offers both Spray Deaerators, **Bulletin 2357** and Tray Deaerators, **Bulletin 4732.**

Water treatment chemicals: Permutit offers an extensive line of specialized chemicals. Typical data available: **Bulletin CS-105** on Wisprofloc-20 Coagulant Aid, **Bulletin CS-111** on Neutralizing Amines, **Bulletin CS-110** on the Permutit Briquet System.

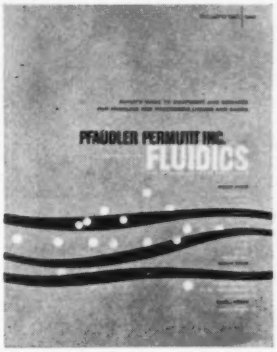


Standard packaged demineralizers: Factory-assembled, systems ready to connect and operate. For summary of applications, plus data on mixed-bed, two-step, non-regenerable and skid-mounted units, send for **Bulletin 4721.**

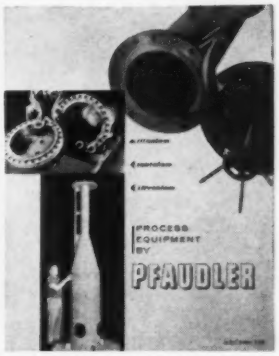
High-capacity water softening: New Permutit® Model BD Softeners answer need for more soft water at lower cost. Details on operation, specifications and performance are in **Bulletin 4696.** Industrial water softening with Permutit automatic equipment, Multiport Valve,® cation exchange, (zeolite) sodium cycle, systems and operation is described in **Bulletin 2386.**



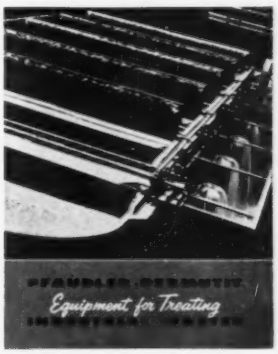
Ion exchangers: From Permutit—the only company to manufacture ion exchange resins and the equipment in which they are used—you can get a brief manual on use of ion exchange as a unit process for purification, recovery, addition, separation, concentration. **Bulletin 2508** covers Permutit resins and equipment.



How FLUIDICS works for you: Buyer's Guide surveys equipment for water and waste treatment, ion exchange, gas analysis, metering and control. Also equipment for handling corrosives, heat transfer, reactions, centrifuging and packaging. Send for **Bulletin 992.**



"New" metals for processing: Tantalum, titanium and zirconium are finding increased use, because of their exceptional corrosion resistance and strength. Corrosion, heat transfer and general application data on these metals, plus equipment available, are discussed in **Bulletin 978.**



Treating industrial wastes: Bulletin 4486 discusses types of industrial waste problems, equipment used, typical waste treatment systems.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

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- ☐ 2386 Zeolite Water Softeners
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- ☐ 4351 Permutit Automatic Valveless Gravity Filter
- ☐ 2508 Permutit Ion Exchangers
- ☐ 2204C Permutit® Precipitator
- ☐ CS-105 Permutit Wisprofloc-20 Coagulant Aid
- ☐ CS-111 Permutit Neutralizing Amines
- ☐ CS-110 Permutit Briquet System
- ☐ 978 Process Equipment by Pfaudler
- ☐ 992 FLUIDICS Buyer's Guide
- ☐ 4486 Equipment for Treating Industrial Wastes
- ☐ 2357 Permutit Spray Deaerators
- ☐ 4732 Permutit Tray Deaerators

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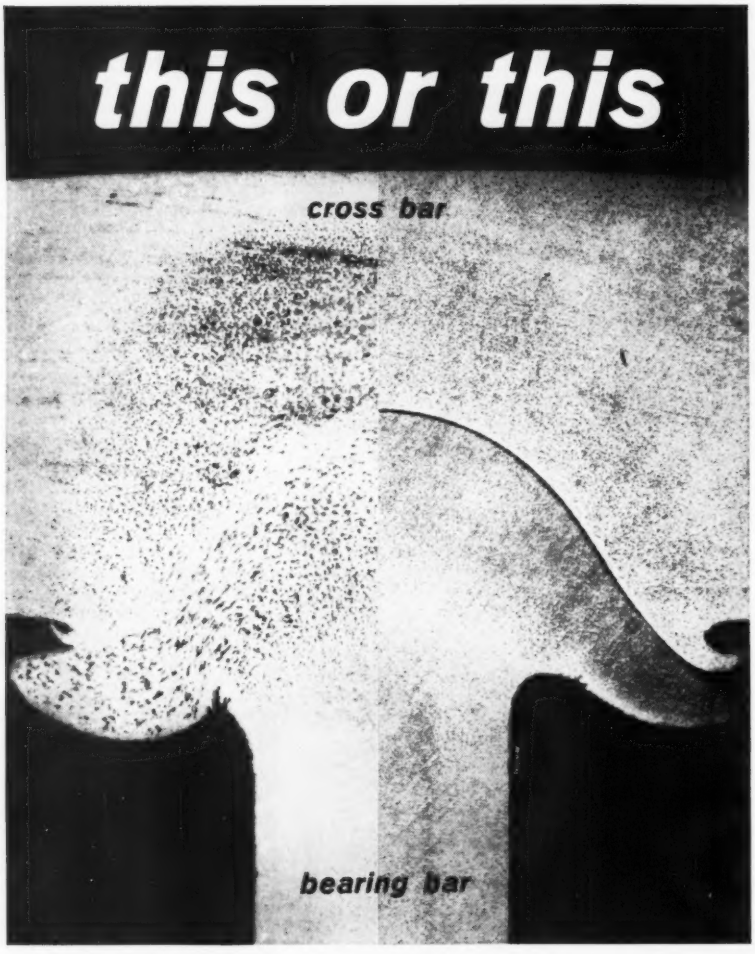
City..... Zone..... State.....



This is Dravo Tru-Weld Grating. In this cross section of a cross bar-bearing bar weld, the metal has fused together. There are no gaps to admit moisture or weaken the joint. It cannot come apart.

Here fusion of metals is incomplete. There is a noticeable gap between bearing bar and cross bar, an open invitation to internal corrosion which can weaken the joint and add to maintenance costs.

which weld for your grating?

Tru-Weld grating is stronger because it is *made* that way. Its added strength comes from a manufacturing process that completely fuses the metal at cross bar-bearing bar joints and holds the bars to exact spacing. The result is grating that stands up under excessive vibration, heavy traffic or in areas where corrosive fumes and moisture are a problem. And Dravo Tru-Weld grating *costs no more.*

Complete estimating, layout and fabricating services are available. Immediate delivery from stocks maintained at nearby Joseph T. Ryerson Service Centers will help you meet exacting construction schedules.

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DRAVO
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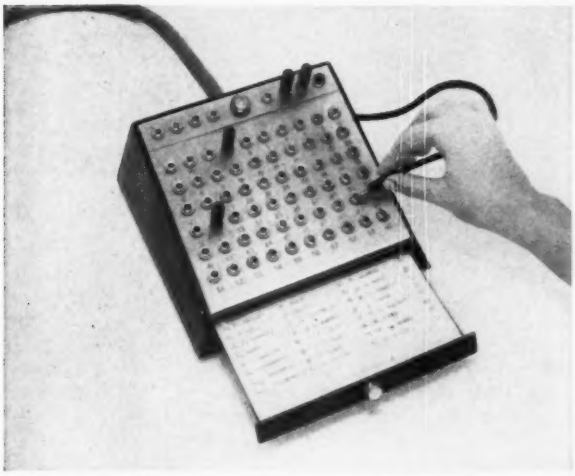
ods of calculating the required radiation characteristics of surfaces, experience with temperature control systems on satellites and lunar probes launched to date, and the methods used for measuring the radiation characteristics of surfaces. Among the topics considered are the sublimation of material into ultrahigh vacuum, the effects of high vacuum on mechanical properties, environmental testing for spacecraft, friction and wear under ultrahigh vacuum, ultraviolet radiation in space and its effect on organic materials, interplanetary dust distribution and its erosion of surfaces, and atomic and molecular sputtering.

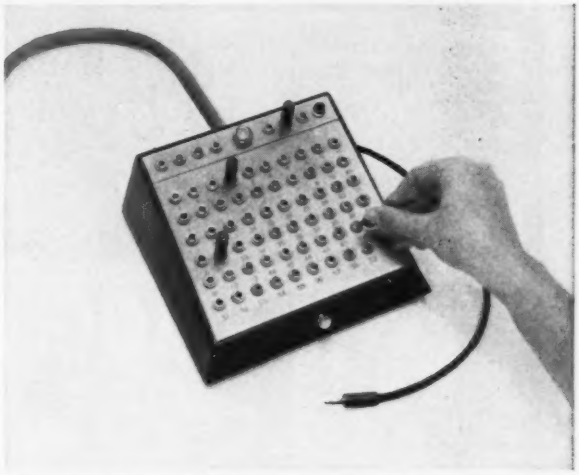
BRIEF COURSE IN ANALYTICS, 3rd ed., by M. A. Hill, Jr. and J. B. Linker; Holt, Rinehart and Winston, Inc., New York, N. Y.; $3.90. New material has been added in this edition to the study of parametric and polar equations, and the treatment of solid analytics has been extended. The book includes such topics as basic definitions and theorems, equations and loci, the straight line, special equations of the second degree, the general equation of the second degree, and elements of solid analytic geometry.

REINFORCED CONCRETE COLUMN TABLES — ULTIMATE STRENGTH DESIGN, by Hugh F. Fenlon; $15. These reinforced concrete column tables have been specially prepared to serve the needs of practicing structural engineers, architects, and designers. The tables include many special features. The most significant of these are the extreme range of values for each column design, the wide range of rectangular column sizes, and the inclusion of values for eccentrically loaded columns both with reinforcing on all four faces and with extra reinforcing on the tension face alone. These tables are based on the Building Code Requirements for Reinforced Concrete of the American Concrete Institute. ▲▲

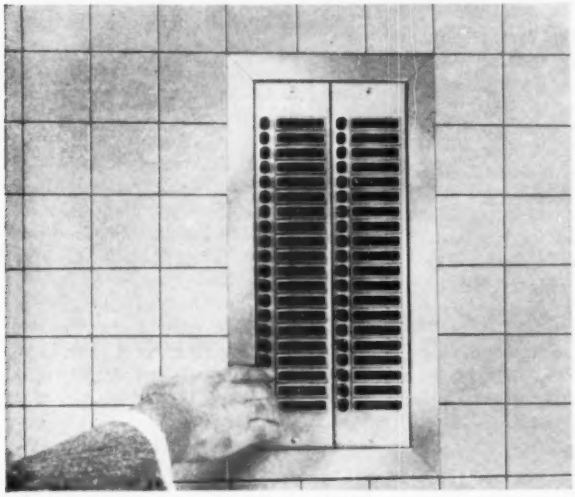
See How the AUTH PAGESAVER SYSTEM Can Boost the Efficiency of Your Hospital!



▲ *Before paging a doctor the operator checks her Pagesaver to see if he is in the hospital. If he is, a white pilot light glows...*



▲ *...but if he is not, she does not page him. Instead, she inserts an "alert" plug in his receptacle on the Pagesaver and leaves it there.*



▲ *When the doctor registers IN, his flashing name on the entrance register informs him that a message awaits him...*

▲ *...and the operator, informed of his arrival by the flashing light of the "alert" plug in her Pagesaver, proceeds to page him.*

The new Auth Pagesaver System benefits all—the hospital, its patients, and its staff. With this unique new system to inform her which doctors aren't in—and to signal her when they come in—the telephone operator won't waste time paging men who aren't there. Patients will rest better with fewer annoying page calls—and their doctors will be located faster when they are needed. Doctors will be alerted earlier to emergency calls. And the hospital, its efficiency and morale boosted by the elimination of hit-or-miss paging, benefits from the resulting goodwill.

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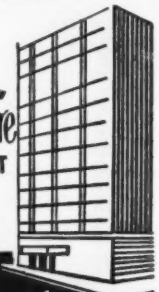

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Consulting Engineers' Calendar

Oct. 2-6. Water Pollution Control Federation; 33rd Annual Meeting, Convention Hall, Philadelphia, Pa.

Oct. 3-5. National Association of Corrosion Engineers and University of California; Corrosion Short Course, San Francisco, California.

Oct. 5-6. The Producers' Council, Inc.; 39th Annual Meeting, Drake Hotel, Chicago, Illinois.

Oct. 3-5. National Association of Corrosion Engineers and University of Oklahoma; Corrosion Short Course, Campus, Norman, Oklahoma.

Oct. 5. Society of Plastics Engineers, Inc.; Technical Conference — "Plastics vs. Corrosion," Mark Hopkins Hotel, San Francisco, California.

Oct. 9-12. American Society of Mechanical Engineers and American Institute of Electrical Engineers; Fuels Conference, Daniel Boone Hotel, Charleston, West Virginia.

Oct. 10-14. American Institute of Electrical Engineers; Fall General Meeting, Chicago, Illinois.

Oct. 10-14. American Society of Civil Engineers; Annual Convention, Hotel Statler, Boston, Massachusetts.

Oct. 25. Association of Consulting Chemists & Chemical Engineers, Inc.; Annual Meeting & Symposium, Hotel Shelburne, New York, N. Y.

Oct. 31-Nov. 2. American Concrete Institute; 13th Regional Meeting, Pioneer Hotel, Tucson, Arizona.

Nov. 10. Consulting Engineers Council; Semiannual Meeting of Board of Directors, Pittsburgh, Pennsylvania.

Nov. 10-11. Kansas City Section, American Society of Civil Engineers; Power Conference, Continental Hotel, Kansas City, Missouri.

Nov. 15-16. Purdue University; Symposium on Engineering Applications of Probability and Random Function Theory, Campus, Lafayette, Indiana.

Nov. 15-17. Building Research Institute; Fall Conferences, Shoreham Hotel, Washington, D. C.

Nov. 27-Dec. 2. American Society of Mechanical Engineers; Annual Meeting and 24th National Exposition of Power and Mechanical Engineering, Statler-Hilton, New York, N. Y.

Jan. 16-19. Instrument Society of America; Winter Instrument-Automation Conference & Exhibit, Sheraton-Jefferson Hotel and Kiel Auditorium, St. Louis, Missouri.

Jan. 23-Feb. 3. Cornell University; Short Course in Photointerpretation and Photogrammetry, Campus, Ithaca, New York.

Jan. 23-Feb. 3. University of California; 1961 Engineering and Management Course, Campus, Los Angeles, California.

Feb. 13-16. American Society of Heating, Refrigerating & Air-Conditioning Engineers; 15th International Heating & Air-Conditioning Exposition, International Amphitheatre, Chicago, Illinois.

Feb. 20-23. American Concrete Institute; 57th Annual Convention, Chase-Park Plaza Hotels, St. Louis, Missouri. ▲▲

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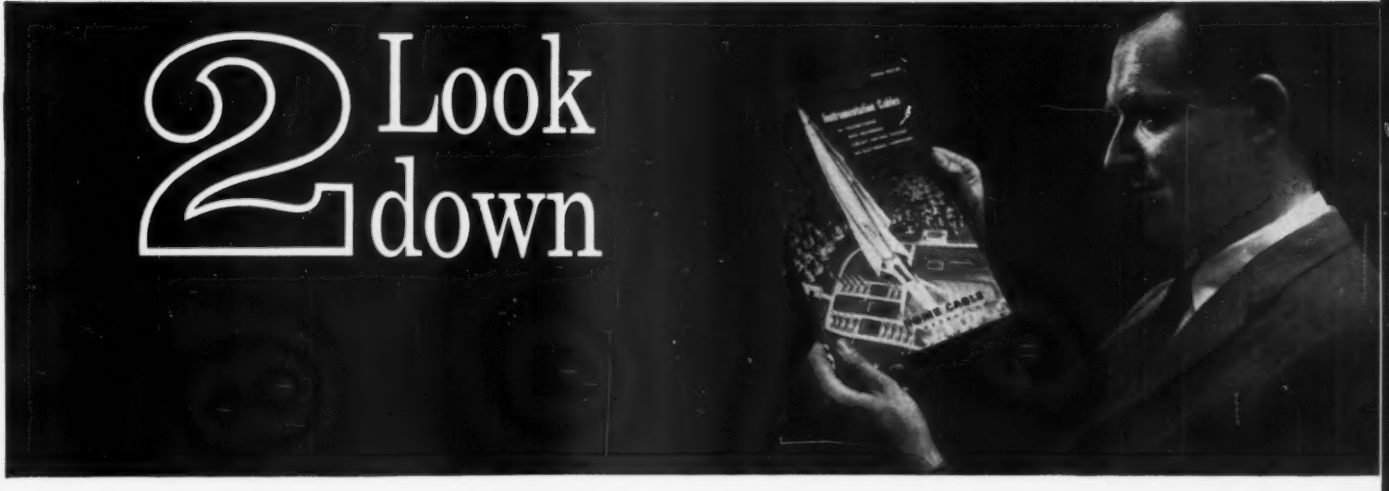

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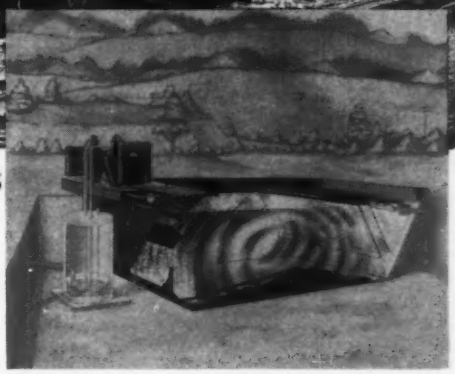

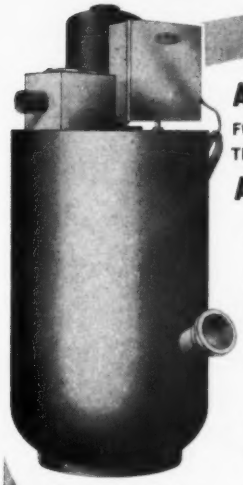

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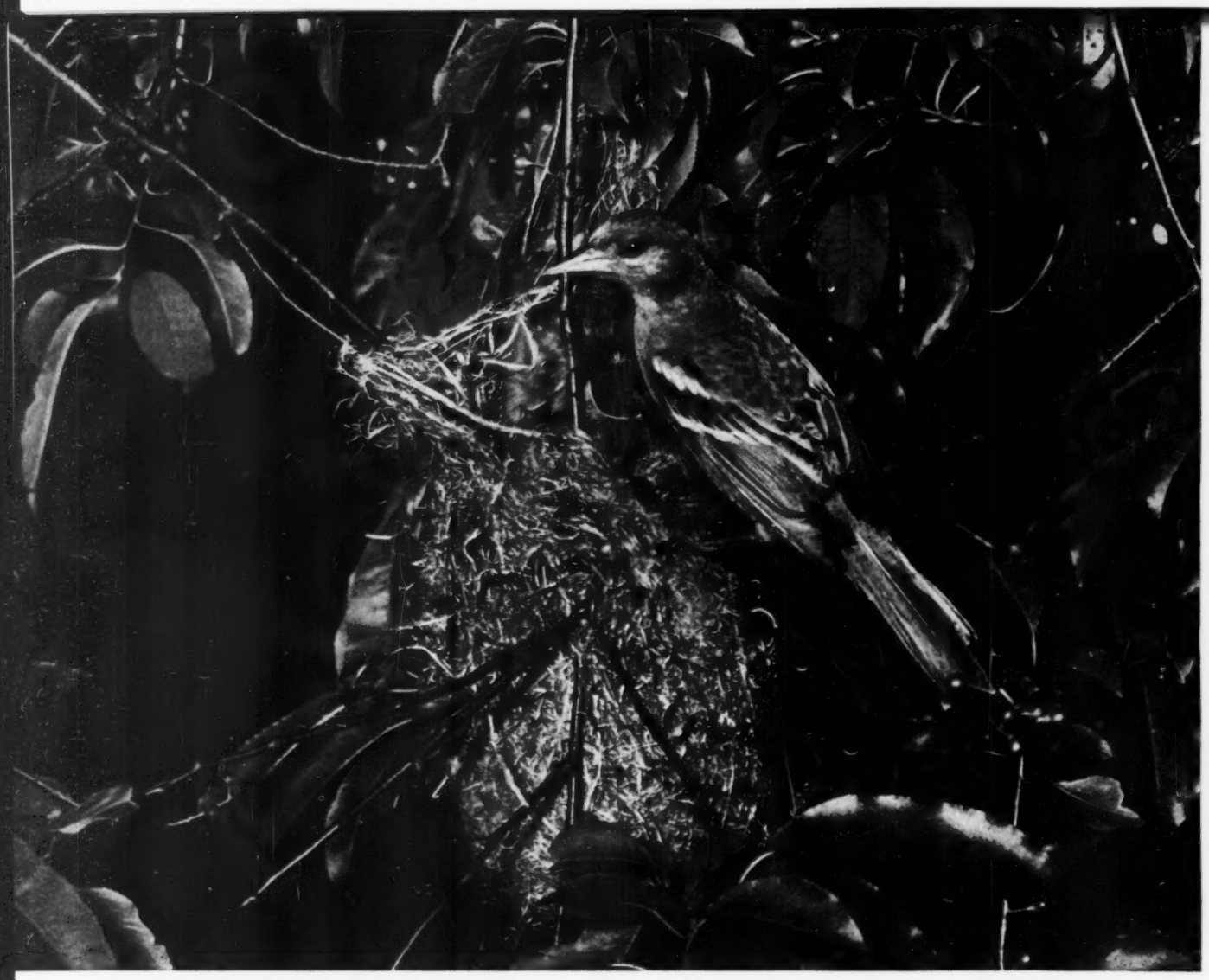

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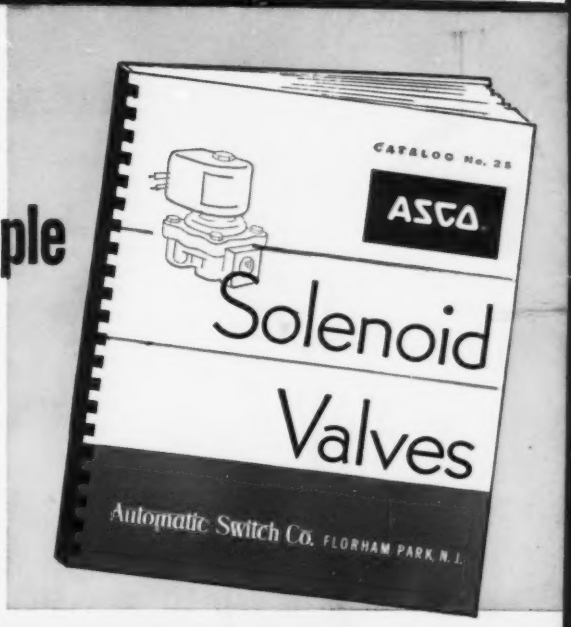
ASCO makes Solenoid Valve selection simple



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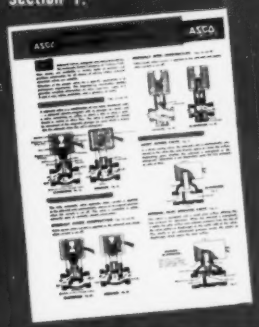

GENERAL ENGINEERING INFORMATION
Expanded engineering data with diagrams, gives valve construction, operating principles, features. With nomographs using Cv ratings for valve sizing.

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Covers all 2-way valves of the fully automatic type for a wide range of pipe sizes and pressures.

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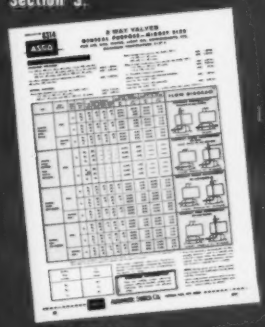
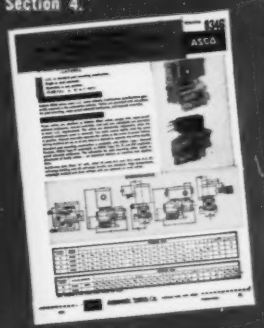


3-WAY VALVES
Detailed information on fully automatic valves for pilot control of diaphragms or cylinders, or for diverting flow in pipelines.

Section 4.

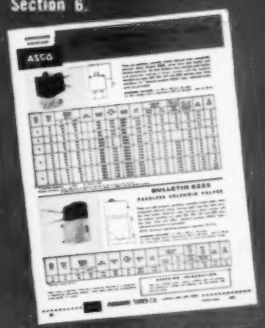


4-WAY VALVES
Fully automatic types covered. Both single and dual solenoid construction for general purpose and J. I. C. requirements.

Section 5.

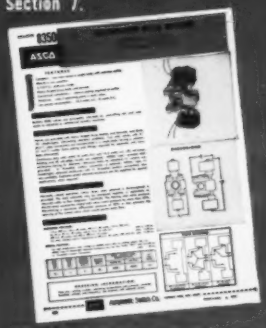
MANUAL RESET VALVES
2 and 3-way solenoid valves for safety shut-off applications.

Section 6.



CORROSION RESISTANT VALVES
Includes 2 and 3-way solenoid valves for handling corrosive gases and liquids. Section incorporates a selection guide chart.

Section 7.



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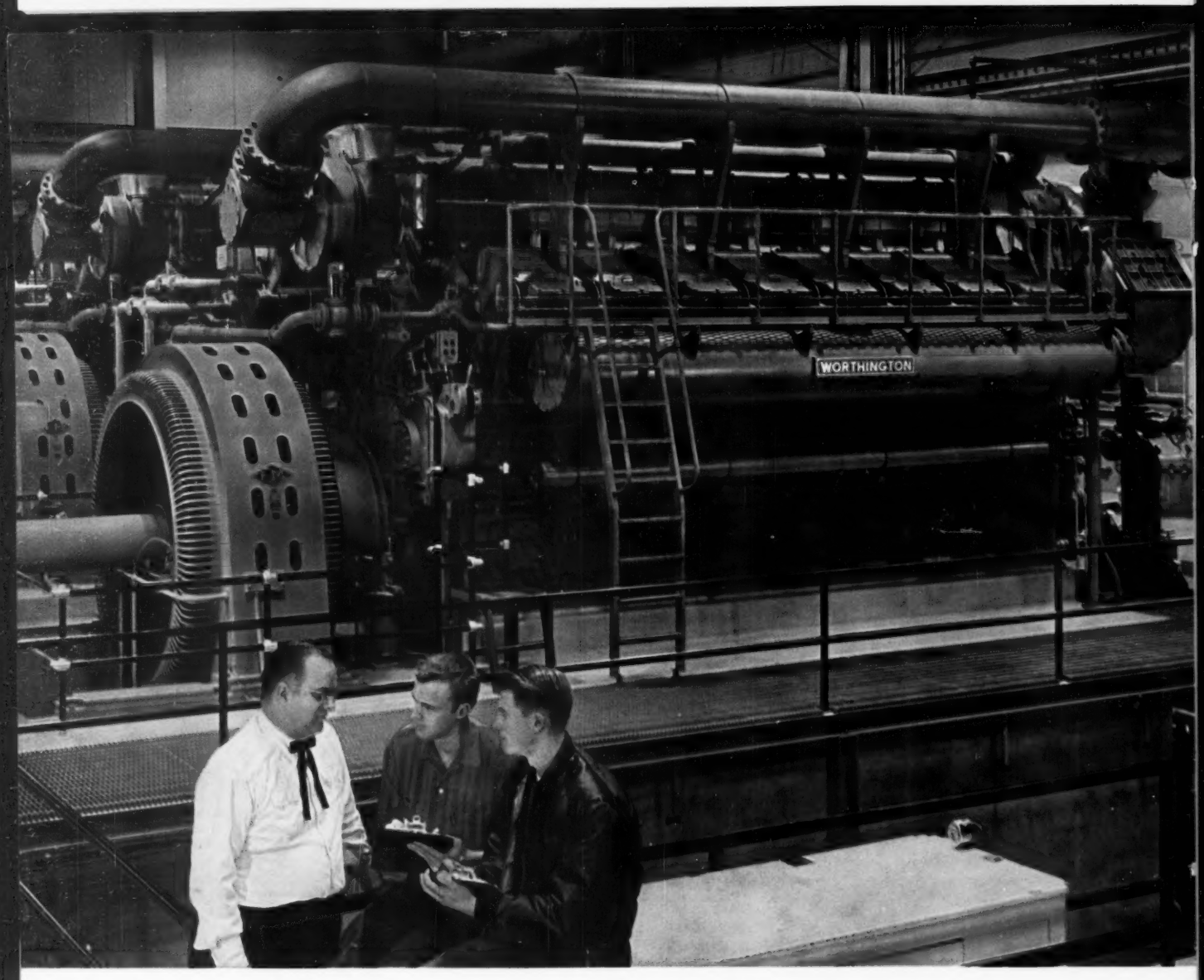

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One value, for example, is that these engines never seem to quit. Prime reason is their slow rotative speeds—the fastest Worthington diesel turns a relatively slow 450 rpm. In fact, one Worthington engine clocked over 13 years of operating life on its original pistons and liners.

Another value is that fuels can be switched at the drop of a price. Thus for varying fuel costs, the Worthington engine that runs on gas, diesel oil or a mixture of both is increasingly desirable. Through this dual fuel operation, many municipalities, private utilities and industrial plants have reported fuel saving up to $5,000 a month.

Turbocharging muscles are, of course, essential. How important? A typical Worthington turbo-charged engine is 15-20% more efficient than the best naturally aspirated unit. Today every user knows how turbo-charging pays off. Yet today only Worthington is squeezing the most from it by designing for high pressure operation above 200 bmep. This latest engine is the Worthington SW14, now proved by over 200,000 hours of operation. Built in ratings from 1,500 to 5,000 hp, it has all fuel and other options that make these engines so versatile.

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To learn more about these big stationary engines, we'd like to send you a copy of "Engine-eering." It's a folder of recently published articles on these engines. Please write Worthington Corporation, Section 43-15, Harrison, New Jersey.

WORTHINGTON